Department of Applied and Computational Mathematics and Statistics Colloquium

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Are there any community structures in a hypergraph?

Many complex networks in the real world can be formulated as hypergraphs where community detection has been widely used. However, the fundamental question of whether communities exist or not in an observed hypergraph still remains unresolved. The aim of the work is to tackle this important problem. Specifically, we study when a hypergraph with community structure can be successfully distinguished from its Erdos-Renyi counterpart and propose concrete test statistics based on hypergraph cycles when the models are distinguishable. Our contributions are summarized as follows. For uniform hypergraphs, we show that successful testing is always impossible when average degree tends to zero, might be possible when the average degree is bounded, and is possible when the average degree is growing. We obtain asymptotic distributions of the proposed test statistics and analyze their power. Our results for growing degree case are further extended to nonuniform hypergraphs in which a new test involving both edge and hyperedge information is proposed. The novel aspect of our new test is that it is provably more powerful than the classic test involving only edge information. Simulation and real data analysis support our theoretical findings.

Monday, January 21, 2019
4:15 PM – 5:15 PM
127 Hayes-Healy Center

Colloquium Tea 3:45 PM to 4:15 PM 101A Crowley Commons Room