

Group-level network inference via l_0 shrinkage and graph combinatorics

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Abstract: We consider group-level statistical inference for networks, where the outcome variables of each subject are multivariate edges in an adjacency matrix. We assume the nodes of adjacency matrices are identical across all subjects and the goal is to identify and statistically test whether edges in some subnetworks that are associated with the covariates of interest. We propose a group level network inference (GLEN) framework to extract the subgraphs where edges are likely to be related to the covariate via l_0 norm regularization and perform statistical tests on the detected subgraphs by graph combinatorics. Theoretical properties of the novel objective function and network-level inference are provided. We apply the proposed method to a brain connectomic study to identify the subnetworks of brain-connectome that are associated with brain diseases. In addition, we perform extensive simulation studies. The results demonstrate the proposed method outperform existing multivariate statistical methods by simultaneously improve false positive and false negative discovery rates and significantly increase replicability.