Abstract.

Multi-layer and multiplex networks show up frequently in many recent network datasets. We consider the problem of identifying the common community membership structure of a finite sequence of networks, called multi-relational networks, which can be considered a particular case of multiplex and multi-layer networks. We propose two scalable spectral methods for identifying communities within a finite sequence of networks. We provide theoretical results to quantify the performance of the proposed methods when individual networks are generated from either the stochastic block model or the degree-corrected block model. The methods are guaranteed to recover communities consistently when either the number of networks goes to infinity arbitrarily slowly, or the expected degree of a typical node goes to infinity arbitrarily slowly, even if all the individual networks have fixed size and are sparse. This condition on the parameters of the network models mentioned above is both sufficient for consistent community recovery using our methods and also necessary to have any consistent community detection procedure. We also give some simulation results to demonstrate the efficacy of the proposed methods.