

Estimating Joint Latent Space Models for Network Data with High-Dimensional Node Variables

Xuefei Zhang

University of Michigan
E-mail: xfzhang@umich.edu

Abstract: Network latent space models assume each node is associated with an unobserved latent position in a Euclidean space, and such latent variables determine the probability of two nodes connecting with each other. In many applications, nodes in the network are often observed along with high-dimensional node variables. These node variables provide important information for understanding the network structure, however the classical network latent space models have several limitations for incorporating them. In this paper, we propose a joint latent space model where we assume that the latent variables not only explain the network structure, but also are informative for the multivariate node variables. We develop projected gradient descent algorithm that estimates the latent positions using a criterion incorporating both network structure and node variables. We establish theoretical properties of the estimators and provide insights on how incorporating high-dimensional node variables information could improve the estimation accuracy of the latent positions. We demonstrate the improvement in latent variable estimation and the improvements in associated downstream tasks, such as node variables missing value imputation, by simulation and application to a Facebook data example.