A BAYESIAN DYNAMIC BLOCK MODEL FOR MULTILAYERED NETWORKS

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ABSTRACT. As network data become increasingly available, new opportunities arise to understand dynamic and multilayer network systems in many applied disciplines. Statistical modeling for multilayer networks is currently an active research area that aims to develop methods to carry out inference on such data. Recent contributions focus on latent space representation of the multilayer structure, and underlying stochastic processes to account for network dynamics, although inference is limited to small graphs as methods do not scale well to large problems. In this paper we introduce a dynamic multilayer network model based on stochastic blocks. We show how the block structure clusters the likelihood into a reduced set of informative components that can be used directly to build a latent network model, which is estimated via Gibbs sampling using Pólya-Gamma data augmentation. Results from extensive simulations on synthetic data suggests the proposed model is a good alternative to learn multilayer networks containing graphs up to 1,000 nodes, if we can assume a structured graph. This assumption holds true for many real networks, such as social or transportation networks, where community structure naturally arise. We present a case study using real data from an airline system, a classic example of hub-and-spoke network.

Keywords: Dynamic Networks; Latent Space; Gaussian Processes; Transportation

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