Directed Markov Multi-graph Models for Network Data

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Abstract

Directed multi-graphs of network data are studied in this paper. By assuming that an observed network is a discrete realization of a dynamical Markov directed graph process, a parametric model is proposed to describe graph change. The proposed model is a scale-free network, where the network dynamics are based both on a preferential linking mechanism and an initial attractiveness of nodes in the network. Since real networks are usually self-organized into a common topological structure, the proposed model is found to capture many of the common properties of real networks. An asymptotic maximum likelihood estimation procedure on model parameters is also developed. Applications of the model on routers network of financial and economic data and the Web Google network are examined. Validation on fitted models is conducted based on predictions of average in-degree and average out-degree of a randomly selected node. The result confirms that the proposed model is sufficiently adequate to model financial and economic networks.