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A Neighborhood Exploration Approach with Multi-start for Extend Generalized Block-modeling

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Abstract

Block-modeling is a framework to describe a social network as a small structure. We propose here a Neighborhood Exploration Approach with Multi-start for tackling the Extend Generalized Block-modeling. The Extend Generalized Blockmodeling is the first and most complete model approach: it allows to analyze networks without any a priory knowledge about them. The other models require at least to know the size of the partition (i.e. the number of sub-sets that the partition will contain) and a pre-definition of the ideal models.

Keywords: Block-modeling, Multi-Start, Clustering, Social Network Analysis.

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1 Introduction

More and more social networks become accessible and, even for small networks, the quantity of data that they carry can be quite huge. There is an increasing need of transforming this data into something more comprehensive which can allow social analysts to theorize and analyse data in order to extract information.

Block-modelling is a framework to describe a social network as a small structure, which can be easily interpreted, by clustering units regarding some kind of equivalence. The obtained structure is a reduced graph (whose nodes are the clusters), which is represented as a relational matrix, the so-called image matrix. It can be specified or obtained as process result. The main idea of equivalence is to find predefined patterns of relations among actors of the network, where every predefined pattern also know as ideal block, has a social meaning.

The conventional part of the block-modelling framework is designed to deal with two type of equivalences: structural equivalence and regular equivalence. Structural equivalence is very strict and does not correspond to most of the real relationships. Regular equivalence is an attempted to make it more flexible and is considered as a weak property. The notion of equivalence has been merged into a more general framework where the relations between the clusters (the image matrix) must be as closed as possible to ideal blocks. For instance, the complete ideal block, that is a block where all the entries are 1, correspond to the structural equivalence. The generalized block-modelling expand the possibilities of the framework, but also require some previous knowledge, as the size of the partition and a pre-definition of the ideal models.

The extend generalized block-modelling, introduced here, makes possible to analyse networks without any priory knowledge about them.

2 Background

A network is defined as $N = (V, R)$ where V is a set of units/nodes and R a set of edges that can also be considered as a binary matrix $S : (v_i, v_j) \in R \Leftrightarrow S_{ij} = 1$. A cluster is a set of nodes which share structural characteristics defined in terms of a given relation. A set of cluster form a *clustering* $C = \{c_1, c_2, \ldots, c_n\}$ which is also a partition of the set $V : \bigcup_{i=1}^{n} c_i = V$ and $c_i \cap c_j = \emptyset, \forall\ i \neq j$.

The clustering C also divide the relation R into blocks: $R(c_i, c_j) = R \cap c_i \times c_j$. The block is considered as the set of ties from all nodes in c_i to all