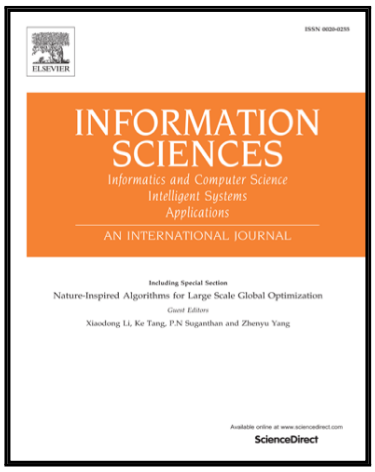

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Power Series Models of Self-Similarity in Social Networks

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Abstract
The evolution of a social network is associated with replicating self-similarity at many levels, the nature of interconnections can serve as a measure of the optimality of its organization. Closeness to self-similarity in the interconnections is proposed as a measure of the optimality of the organization. Two power series models are proposed to represent self-similarity and they are compared to the Zipf and Benford distributions. In contrast with the Zipf distribution where the middle term is the harmonic mean of the adjoining terms, our distribution considers the middle term to be the geometric mean. In one of the power series models, the scaling factor at one level is shown to be the golden ratio. A model for evolution of networks by oscillations between two different self-similarity measures is described.

Keywords: Social networks, self-similarity, 80-20 phenomenon, connectivity, golden ratio

1. Introduction

A social network consists of N nodes, labeled 1, 2, … n, that may be people, firms, or other entities. The network is represented by a graph where the connection between the nodes *i* and *j* is shown by a link between the two. A network may be valued for the function it performs to nodes outside of it, or it may be valued for the function it serves to the nodes within [2]. Unlike engineered networks whose function (to nodes outside the network) is well-defined, goodness of social networks cannot be easily quantified because the entity that is scarce is attention which requires a different kind of economics [12, 13, 11, 29] and also because of the elusiveness of the inner experience of well-being. Nevertheless, for the entire network one speaks of some general function such as value, utility, well-being, or welfare of the group whose definition is driven by extraneous considerations of theory or ideology [21].

In economic networks [4, 10, 25] where value must be associated with the nodes within, one speaks of Pareto efficiency, or Pareto optimality, which is a state of allocation of resources in which it is impossible to make any one individual better off (in terms of a suitable measure of well –being) without making at least one individual worse off. A state is Pareto efficient or optimal when no further improvements can be made. The allocation, normally in terms of resources, could also be in terms of some property of the connectivity. We are not concerned with the cost of the connections and interested primarily in natural connectivity as determined by fundamental considerations.

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