

Networks, topology and dynamics

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Interest in network analysis has grown in recent years. Many social, economic and financial systems with large numbers of interacting agents can be conveniently described by a network. In the last decade, new theories have been developed to highlight the topological properties of network architectures, despite their apparent randomness. Networks, moreover, once included in a dynamic setting, prove to be convenient mathematical tools in modeling many phenomena. This special issue of Quality and Quantity aims at providing a state-of-the-art overview of the research currently in progress at the global level, with a special focus on applications to Economics and Social Sciences. A wide range of recent advances is offered, both theoretical and methodological, that can be of interest for academics as well as practitioners. It includes nine papers, selected through a process of blind refereeing among the communications held at NET 2010 (IULM, Milano) and NET 2011 (Milano-Bicocca, Milano) Conferences. The issue comprises roughly four Sections: Network Dynamics, Network Applications, Network Modeling, Decision Modeling.

1 Network dynamics

Network dynamics is observed both on the empirical and the theoretical point of view, giving new interesting insights to a topic in progress. In *Measuring dynamics and structural change of time dependent socio-economic networks* by R. Grassi and M. Fattore, the issue of modeling network dynamics is studied. Network dynamics is split into two components: structural, accounting for changes in the network topology, and non structural, accounting for permutation of vertex labels. A quantitative measure of the dynamics is then proposed and it is shown how it can be used to investigate the time evolution of a network. The theoretical results

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are applied to a subnetwork of the Italian corporate board. The dynamics of the exchange rate network of 28 countries is studied in *Network analysis of exchange data: Interdependence drives crisis contagion* by D. Matesanz and G. Ortega to find effect of interdependence and possible contagion. MST and global correlation coefficients are calculated to observe the co-movements dynamics throughout the time sample. By comparing Pearson and Phase Synchronous information, a new methodology is emphasized. Some evidence of contagion in the Asian currency crises is found; in particular, stable interdependence drives contagion. The leader emergence in an artificial social network is studied by A. Dal Forno and U. Merlone in *Leader emergence in artificial populations: the role of networks*. Structural balance and the mutual relationship among actors are taken into account when modeling the attitude toward the leader. The adaptation process to achieve the balance is also considered as well as the role of free riders. A rapid and smooth convergence path to a socially stable equilibrium is proved to be difficult.

2 Network applications

In *Patterns of University—Industry Interactions in Brazil; an Exploratory analysis using the instrumental of Graph Theory* by J. Brito and R. Del Vecchio, the interaction between Universities and industry in Brazil is studied, with the analytical contribution of graph theory and its centrality measures. The importance of locational aspects is highlighted and it is shown to condition the actions of Universities as producers of science and technology. Centrality measures and the Herfindhal–Hirschmann Index (HHI) are used to study the topology of the Italian Stock Market in *Networks of firms: an analysis of market concentration* by G. Rotundo and A.M. D’Arcangelis. The resulting topology is contrasted with a randomized version. New results are added based on the maximum value of HHI, under the scale free constraint, and the fragility of the network under random rewiring is shown.

3 Network modeling

The human interaction evolution in a world characterized by synchronous and asynchronous online networking is modeled in *Bowling alone but tweeting together: the evolution of the human interaction in the social networking era* by F. Sabatini, A. Antoci, M. Sodini. It is shown that when the social environment is poor of participation opportunities and/or the time pressure increases, asynchronous interactions (a blog post, tweeting, etc) help individuals to defend their sociability. The paper *Informal ties in organizations: a case study* by M. D’Errico, S. Stefani and A. Torriero contributes to the analysis of informal ties in an organization by introducing centrality measures in multiple networks based on hubs and authorities. In order to map the informal networks in advice, communication and trust, both joint and univariate network techniques are applied to a case study and the key roles in a family owned consulting company are identified. The concept of mutual awareness, i.e. the perception of giving help and advice as perceived by the recipient, is introduced and analyzed through the Quadratic Assignment Procedure (QAP).

4 Decision modeling

The paper *Quantum Models for decision making and opinion dynamics: the role of the Lie algebras*, by C.M. Sarris and A. N. Proto, investigates the application of quantum mechanical theory in decision making and opinion formation, following the maximum entropy approach

and also analyze the role of the Lie algebras. Throughout this approach important advantages are obtained, in particular: a) a temporal evolution of the process under modeling can be given, b) it provides with a general uncertainty principle which prevents against uncertainty principle violation during the dynamic evolution of the system, c) it reveals the underlying Lie algebra structure which, in fact, is the support of the two previous assertions. The results show how methods from quantum mechanical theory can provide important insights in the structure and dynamics of decision making and opinion formation. In *Reasoning under Uncertainty and Multi-Criteria Decision Making in Data Privacy*, by B. Cavallo, L. D'Apuzzo, G. Canfora and M. Squillante, two distinct and integrated approaches for improving data privacy are presented: Bayesian networks applied to disclosure control in statistical databases, and pairwise comparison matrices, applied to data privacy requirement prioritization. The contribution is original and different contexts from social sciences to economics and engineering will benefit from the findings of this research: e-voting, e-government, e-commerce, e-banking, e-health, cloud computing, risk management, etc. The first approach has received several acknowledgements and awards such as TR35-GI, by MIT Technology Review and "Forum della Ricerca Innovazione Imprenditorialit (RIEForum)".

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