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Aims and Scope

Optimization has been expanding in all directions at an astonishing rate during the last few decades. New algorithmic and theoretical techniques have been developed, the diffusion into other disciplines has proceeded at a rapid pace, and our knowledge of all aspects of the field has grown even more profound. At the same time, one of the most striking trends in optimization is the constantly increasing emphasis on the interdisciplinary nature of the field. Optimization has been a basic tool in all areas of applied mathematics, engineering, medicine, economics, and other sciences.

The series *Springer Optimization and Its Applications* publishes undergraduate and graduate textbooks, monographs and state-of-the-art expository work that focus on algorithms for solving optimization problems and also study applications involving such problems. Some of the topics covered include nonlinear optimization (convex and nonconvex), network flow problems, stochastic optimization, optimal control, discrete optimization, multi-objective programming, description of software packages, approximation techniques and heuristic approaches.

More information about this series at <http://www.springer.com/series/7393>

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Network Models in Economics and Finance

 Springer

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*If you consider what are called the virtues
in mankind, you will find their growth
is assisted by education and cultivation.*

Xenophon, Greek philosopher (431–355 BC)

Preface

The theory of networks is nowadays a powerful tool in different research fields. This volume presents the state of the art in the investigations of network models in economics and finance. The contributors in the volume are known experts and active researchers in this direction.

In the chapter “Experimental Design Problems and Nash Equilibrium Solutions” by Egidio D’Amato, Elia Daniele, and Lina Mallozzi, the authors present a noncooperative game theoretical model for the well-known problem of experimental design. They provide theoretical and computational results for this location problem.

In the chapter “A Variational Approach to the Evolutionary Financial Equilibrium Problem with Memory Terms and Adaptive Constraints” by Annamaria Barbagallo, Patrizia Daniele, Mariagrazia Lorino, Antonino Maugeri, and Cristina Mirabella, the authors consider an evolutionary financial equilibrium problem where the risk assessment depends on previous equilibria and adaptive equality constraints are considered. A quasi-variational formulation is provided and an existence theorem is proved.

In the chapter “Robustness of Sign Correlation in Market Network Analysis” by Grigory A. Bautin, Alexander P. Koldanov, and Panos M. Pardalos, the authors study a different similarity measures in market network analysis from the point of view of associated statistical procedures. It is proved that the use of sign correlation leads to robust statistical procedures in the class of elliptically contoured distributions in contrast with Pearson correlation which is very sensitive to the specific form of distribution.

In the chapter “Two Classes of Games on Polyhedral Sets in Systems Economic Studies” by Alexander S. Belenky, two classes of two- and three-person games on polyhedral sets of player strategies that appear in estimating fair shares of the market participants in a marketplace are considered. For the games from both classes either sufficient or necessary and sufficient conditions of the equilibriums are provided, and these conditions allow one to calculate the equilibriums by effective optimization techniques. This fact contributes to making the equilibrium concept a productive approach to quantitatively analyzing conflicts in

systems economic studies. Economic problems that appear in systems described by nonlinear mathematical models with linear constraints are studied with the help of associated network models.

In the chapter “Densely Entangled Financial Systems” by Bhaskar DasGupta and Lakshmi Kaligounder, the authors consider a banking network model, and study the banks’ behavior in counter-party risk hedging. They show that as the number of counter-party neighbors increases the probability of counter-party risk also increases, and in particular the socially optimal solution becomes privately sustainable when each bank hedges its risk to at least half of the banks in the network.

In the chapter “Sigmoid Data Fitting by Least Squares Adjustment of Second and Third Divided Differences” by Ioannis C. Demetriou, the author considers the performance of two data smoothing methods that provide sigmoid fits by adjustment of divided differences on some test problems. The first method is a least squares data smoothing calculation subject to nonnegative third divided differences. The second method is a non-linear least squares data smoothing calculation subject to one sign change in the second divided differences. The results expose some strengths and weaknesses of the methods. This can be useful to particular scientific analyses, e.g. sigmoid phenomena, and to strategic management practices, i.e. economic substitution.

In the chapter “Financial Modeling Under Multiple Criteria” by Michael Doumpos and Constantin Zopounidis, the authors discuss the specifics of financial modeling, which is mainly based on a normative and descriptive approach adapting the wealth maximization principle. They also consider the multicriteria decision aid (MCDA) paradigm that extends and enhances the framework, emphasizing the multidimensional aspects of financial decisions. An up-to-date review of the relevant literature in these two areas is also presented.

In the chapter “Agent-Based Models of Stock Exchange: Analysis via Computational Simulation” by Lyudmila G. Egorova, the author introduces simulation models of stock exchange to explore which traders are successful and how their strategies influence to their wealth and probability of bankruptcy.

In the chapter “Network Centrality and Key Economic Indicators: A Case Study” by Andreas Joseph and Guanrong Chen, the authors investigate the relations between radial and medial network centrality measures in different types of cross-border portfolio investment networks and macroeconomic indicators related to the financial conditions of central governments for most OECD (Organization for Economic Co-operation and Development) countries during 2001–2011, where they consider the level of central government debt as percentage of national GDP (Gross Domestic Product) and the interest rates on long-term government bonds. This provides additional insights into topics such as the coupling of interest rates, observed during the European Debt Crisis 2009–2012, and points to underlying conflicts of interest on a national or international level, which may be taken into account when it comes to monetary and economic policy actions.

In the chapter “Network Structures Uncertainty for Different Markets” by Valery A. Kalyagin, Petr A. Koldanov, and Victor A. Zamaraev, the authors consider net-

work model of stock market based on the correlation matrix. Statistical uncertainty of some popular market network structures is analyzed by numerical simulation for network models of stock markets for different countries. For each market the statistical uncertainty of different structures is compared. The main finding is that the results of comparison are nearly the same for different markets. This leads to conjecture that there are some unknown common features in different market networks.

In the chapter “Complexity Analysis and Systemic Risk in Finance: Some Methodological Issues” by Charilaos Mertzanis, complexity theory and network analysis are used to study financial crises and in particular to identify the extent to which the financial system is resilient to contagion as well as the nature of major triggers and channels of contagion. The use of complexity analysis in finance draws on two distinct but related strands of theory: econophysics and econobiology. Each strand is associated with advantages and drawbacks in explaining the dynamics of financial systems. Properly combined, these theories are shown to form a coherent body of theoretical premises that are capable of approximating reality in financial systems.

In the chapter “A Dynamic Network Economic Model of a Service-Oriented Internet with Price and Quality Competition” by Anna Nagurney, Dong Li, Sara Saberi, and Tilman Wolf, the authors describe a dynamic network economic model of a service-oriented Internet with price and quality competition using projected dynamical systems theory. They study the model with computational procedures and show its generality.

In the chapter “European Business Cycle Synchronization: A Complex Network Perspective” by Theophilos Papadimitriou, Periklis Gogas, and Georgios-Antonios Sarantitis, the authors study synchronization of business cycles across Europe, and compare the phenomenon of synchronization before and after the introduction of the single European currency. The main finding is that the introduction of the common currency has significantly influenced and increased macroeconomic convergence.

In the chapter “A Novel Banking Supervision Method Using the Minimum Dominating Set” by Periklis Gogas, Theophilos Papadimitriou, and Maria-Artemis Matthaïou, the interrelations of banking institutions under the framework of Complex Networks are studied. Specifically, an auxiliary early warning system for the banking system’s supervisor that would be used in addition to the existing schemes of control is provided. The Minimum Dominating Set (MDS) methodology to reveal the most strategically important banks of the banking network and use them as alarm triggers is applied. It is shown that using this methodology the regulators can have an overview of the whole network.

The book is useful for everyone who is interested in modern approaches to the study of important problems in economics and finance and especially is oriented to the young researchers to facilitate their introduction in this new and fascinating area. Some of the papers of the book were presented and discussed at the international conference “Network Models in Economics and Finance” (June 13–15, 2013, Athens, Greece) organized by the Laboratory of Algorithms and Technologies

for Networks Analysis of the National Research University Higher School of Economics (Russia), the Center for Applied Optimization of the University of Florida (USA), and the National Technical University of Athens (Greece).

We would like to take this opportunity to thank the contributors, the anonymous referees, and Springer for helping us in the publication of this book. Special thanks are due to Grigory Bautin for helping us with the conference and the processing of all submissions.

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