Preface

Networks permeate our daily lives, underpinning our economies and societies and provide the infrastructure for business, science, technology, social systems, and education. Transportation networks give us the means to cross physical distance in order to see clients and conduct business, as well as to visit colleagues and friends and to explore new vistas and expand our horizons. They enable manufacturing processes through the supply of the necessary input components and the ultimate distribution of the finished products to the consumers.

Communication networks, in turn, allow us to access and to share data within our communities and across regions and national boundaries and to inform others as well as to be informed. Energy networks help to fuel not only transportation networks but in many settings also communication networks. They provide electricity to run the computers and to light our businesses, oil and gas to heat our homes and to power vehicles, and water for our very survival.

Financial networks supply businesses with the resources to expand, innovate, and to satisfy the needs of consumers. They allow individuals to invest and to save for the future for themselves and for their children and for governments to provide for their citizens and to develop and enhance communities.

The advent of the Information Age with the increasing availability of new computer and communication technologies, along with the Internet, have transformed the ways in which individuals work, travel, and conduct their daily activities, with profound implications for existing and future networks. Moreover, the decision-making process itself has been altered due to the addition of alternatives and options which were not, heretofore, possible or even feasible. The boundaries for decision-making have been redrawn as individuals can now work from home or purchase products from work. Managers can now locate raw materials and other inputs from suppliers through information networks in order to maximize profits while simultaneously ensuring timely delivery of finished goods. Financing for their businesses can be ob-
tained online. Individuals, in turn, can obtain information about products from their homes and make their purchasing decisions accordingly.

The reality of today’s networks include: large-scale nature and complexity, increasing congestion, alternative behaviors of users of the networks, as well as interactions between the networks themselves, notably, between transportation and telecommunication networks. The decisions made by the users of the networks, in turn, affect not only the users themselves but others, as well, in terms of profits and costs, timeliness of deliveries, the quality of the environment, etc.

In this book, we lay out the theory of supernetworks in order to formalize decision-making in the Information Age. “Super” networks are networks that are “above and beyond” existing networks, which consist of nodes, links, and flows, with nodes corresponding the locations in space, links to connections in the form of roads, cables, etc., and flows to vehicles, data, etc. Supernetworks are conceptual in scope, graphical in perspective, and, with the accompanying theory, predictive in nature.

In particular, we seek to capture, within a unifying framework, decision-making facing a variety of economic agents including consumers and producers as well as distinct intermediaries in the context of today’s networked economy. The decision-making process may entail weighting trade-offs associated with the use of transportation versus telecommunication networks. The behavior of the individual agents is modeled as well as their interactions on the complex network systems with the goal of identifying the resulting equilibrium flows and prices.

This book provides the conceptual, analytical, and computational tools for the study of supernetworks. The approach is rigorous and of sufficient generality and detail to give added insight into the behavior and structure of large-scale, interacting and competitive network systems, consisting of numerous agents and alternatives.

This book consists of four parts, with a total of twelve chapters. The first part provides an introduction, discusses the origins of supernetworks, and lays the foundations for their study. Part II then focuses on multitiered supernetworks with applications to supply chain networks with electronic commerce and financial networks with intermediation. Dynamic versions of the models are studied using a multilevel network perspective. Part III turns to multicriteria network equilibrium models and addresses such relevant topics in the Information Age today as: telecommuting versus commuting decision-making, teleshopping versus shopping decision-making, as well as location and transportation decision-making. Part IV describes new directions for supernetworks by providing extensions and syntheses of some of the earlier material in this book.

The intended audience for this book includes students, researchers, and practitioners in economics and business, in computer science, in engineering, and in operations research and management science, who are interested in the
formulation, qualitative analysis, application, and computation of complex network systems in the Information Age.

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