

Fragile Networks: Identifying Vulnerabilities and Synergies in an Uncertain World

Description: A unified treatment of the vulnerabilities that exist in real-world network systems?—with tools to identify synergies for mergers and acquisitions

Fragile Networks: Identifying Vulnerabilities and Synergies in an Uncertain World presents a comprehensive study of network systems and the roles these systems play in our everyday lives. This book successfully conceptualizes, defines, and constructs mathematically rigorous, computer-based tools for the assessment of network performance and efficiency, along with robustness and vulnerability analysis. The result is a thorough exploration that promotes an understanding of the critical infrastructure of today's network systems, from congested urban transportation networks and supply chain networks under disruption to financial networks and the Internet.

The authors approach the analyses by abstracting not only topological structures of networks, but also the behavior of network users, the demand for resources, the resulting flows, and the associated costs. Following an introduction to the fundamental methodologies and tools required for network analysis and network vulnerability, the book is organized into three self-contained parts:

Part I—Network Fundamentals, Efficiency Measurement, and Vulnerability Analysis explores the theoretical and practical foundations for a new network efficiency measure in order to assess the importance of network components in various network systems. Methodologies for distinct decision-making behaviors are outlined, along with the tools for qualitative analysis, the algorithms for the computation of solutions, and a thorough discussion of the unified network efficient measure and network robustness with the unified measure.

Part II—Applications and Extensions examines the efficiency changes and the associated cost increments after network components are eliminated or partially damaged. A discussion of the recently established connections between transportation networks and different critical networks is provided, which demonstrates how the new network measures and robustness indices can be applied to different supply chain, financial, and dynamic networks, including the Internet and electronic power networks.

Part III—Mergers and Acquisitions, Network Integration, and Synergies reveals the connections between transportation networks and different network systems and quantifies the synergies associated with the network systems, from total cost reduction to environmental impact assessment. In the case of mergers and acquisitions, the focus is on supply chain networks. The authors outline a system-optimization perspective for supply chain networks and also formalize coalition formation using game theory with insights into the merger paradox.

With its numerous network examples and real-world applications, Fragile Networks: Identifying Vulnerabilities and Synergies in an Uncertain World is an excellent book for courses in network science, transportation science, operations management, and financial networks at the upper-undergraduate and graduate levels. It is also a valuable reference for researchers and practitioners in the areas of applied mathematics, computer science, operations research, management science, finance, and economics, as well as industrial, systems, and civil engineering.

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- Chapter 1: Introduction and Overview.
- Chapter 2: Fundamental Methodologies, Network Models, and Algorithms.
- Chapter 3: Network Performance Measurement and Robustness Analysis.
- Chapter 4: Application of the Measures to Transportation Networks.
- Chapter 5: Supply Chain Networks with Disruption Risks.

Chapter 6: Critical Nodes and Links in Financial Networks.

Chapter 7: Dynamic Networks, the Internet, and Electric Power.

Chapter 8: A Systemoptimization Perspective for Supply Chain Network Integration.

Chapter 9: Environmental and Cost Synergy in Network Integration.

Chapter 10: Multiproduct Supply Chain Network Integration.

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