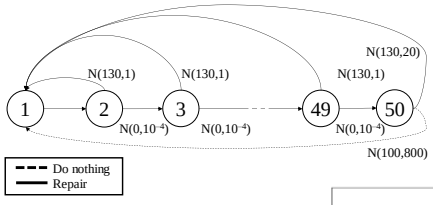
OSU Department of Integrated Systems Engineering

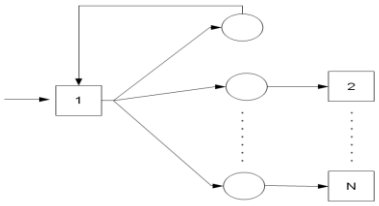
STOCHASTIC MODELING, OPTIMIZATION, AND SIMULATION

Ohio State University hosts an exciting research program on stochastic modeling, stochastic optimization, and simulation. Much of the research is on modeling, analysis, and optimization of real-world systems involving uncertainty. ISE faculty focus on emerging applications ranging from cloud computing to power grids to supply chain management to water resource management to brain imaging to manufacturing to voting systems to retail and market planning to cyber security. The faculty aims at developing new methods that integrate data, modeling, algorithms and application into innovative solutions for efficient management of real-world systems under uncertainty.

Scope. Increasingly, decision-makers want "data-driven" recommendations. Going from data to models to decisions inevitably involves statistics and uncertainty, i.e., "stochastic" modeling. Examples of our projects include simulation-based support in manufacturing, provisioning and pricing of cloud computing resources, optimizing water system holdings for a region, and supporting decisions about which computers need to be cleaned of vulnerabilities in a network. Research in this area concerns developing suitable stochastic models, simulation-based optimization methods, analytical or approximation methods for predicting performance, helping make strategic decisions on resources, and identifying the optimal design for such systems.

Approach. We model the uncertainty using probability and use probability theory, statistics, and simulation to predict behavior or performance. We often embed these within optimization models and methods to make decisions under uncertainty. Research in stochastic modeling often focuses on developing analytical tools for complex models. For example, many real-life systems consisting of customers that wait for service from a collection of servers, can be represented as queueing models. Queuing theory is a body of models and analytical techniques for predicting performance of different designs for such systems. In practice, approximations, numerical methods, or computer simulation are employed often.





Research Contexts

- Cloud computing
- Cyber security management
- Green transportation networks
- Manufacturing systems
- Supply chain management
- Telecommunication networks
- Water resources management
- Voting systems

Research Focus Areas

- Stochastic modeling and analysis
- Stochastic Optimization
- Queueing theory
- Asymptotics of large-scale networks
- Dynamic/adaptive/decentralized control
- Discrete-event system simulation
- Machine learning focusing on optimization
- Monte Carlo Sampling-Based Methods

Faculty: Theodore Allen, Sam Davanloo, Guzin Bayraksan, Nicholas Hall, Cathy H. Xia