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Introduction to the Special Issue on Stochastic Models and Simulation

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The number of publication outlets for research in stochastic models and simulation has grown substantially over the past 10 to 15 years. What, then, should be the role of *Management Science* in this field? How should a *Management Science* paper on stochastic models and simulation differ from a paper in a more specialized journal?

These are questions I have often asked myself as a member of the journal's editorial board, most recently as a departmental editor. The answers should evolve along with the broader field of management science, but it does seem possible to identify some lasting principles. Articles published in *Management Science* should address issues of interest to a broad audience—even readers who will not study a paper's details should be able to appreciate its topic. Published articles should meet the journal's high standard of rigor, but rigor will usually serve as a mode of communication, ensuring precision and veracity, rather than an end in itself. Perhaps most important is that an article in *Management Science* should excel on a less tangible dimension of *relevance*—relevance to problems in industry and to the research community served by the journal.

Management Science can play an important role in featuring research on stochastic models and simulation that meets these principles; this department can enrich the journal with high quality research addressing interesting applications and broadening awareness of new methodologies. I am enthusiastic about the many new directions of theory and applications emerging in stochastic models and simulation, and I welcome this opportunity to showcase some current research.

Each of the six articles collected here serves to introduce a promising direction for future work, to highlight a new area of application, or to illustrate the use of a developing methodology. Application areas repre-

sented include finance, public health, and telecommunications. The tools used include optimal control, game theory, heavy-tailed distributions, quasi-Monte Carlo, lattice rules, diffusion processes, heavy-traffic approximations, and statistics. These papers reflect a diversity of interesting and relevant research directions in stochastic models and simulation.

In "Path Generation for Quasi-Monte Carlo Simulation of Mortgage Backed Securities," Fredrik Åkesson and John Lehoczky use a stochastic perspective to enhance the effectiveness of a deterministic method. Unlike ordinary Monte Carlo simulation, quasi-Monte Carlo does not attempt to mimic randomness; its analysis has traditionally relied on deterministic tools. This paper adds to a growing awareness that the use of quasi-Monte Carlo can be combined with stochastic ideas to achieve greater computational efficiency. The analysis in the paper is motivated by the computationally challenging problem of valuing mortgage-backed securities and the authors illustrate its application in this setting.

Sid Browne examines portfolio optimization problems in "Risk Constrained Dynamic Active Portfolio Management." In *active* portfolio management, the investor seeks to outperform a benchmark; this paper constrains the risks the investor may take in trying to achieve this objective. Browne formulates an optimal control problem and solves it to find the optimal investment strategy for several types of performance objectives and measures of risk.

Rebecca D'Amato, Richard D'Aquila, and Lawrence Wein address an important public health problem in "Management of Antiretroviral Therapy for HIV Infection: Analyzing When to Change Therapy." Current treatment of HIV-infected patients can involve a combination of antiretroviral drugs; the authors

analyze the trade-offs involved in deciding when to switch from one drug to another. The analysis combines probability approximations and optimizations.

"Variance Reduction via Lattice Rules," by Pierre L'Ecuyer and Christiane Lemieux, is a review article on a class of simulation methods that may not be as well known in the management science community as they ought to be. The authors review the underlying theory of the methodology, discuss recent developments, and illustrate its application to activity networks, option pricing, and queues.

The use of heavy-tailed distributions and models of long-range dependence have generated enormous interest in describing traffic over telecommunications networks and in other applications as well. Sidney Resnick and Gennady Samorodnitsky apply powerful tools from heavy-tailed theory in "A Heavy Traffic Approximation for Workload Processes with Heavy Tailed Service Requirements." Their analysis illust-

rates some of the qualitative differences between heavy-tailed phenomena and more familiar models of traditional queueing theory.

Jan Van Mieghem builds on heavy-traffic approximations in "Price and Service Discrimination in Queueing Systems: Theory and Tools" to develop pricing and scheduling policies. He investigates the role of information about service requirements in setting policies and in determining an economic equilibrium between a service facility and its customers. The use of heavy-traffic approximations helps make the problem tractable and leads to asymptotic optimality results.

I thank these authors for contributing these fine articles to the journal. I am as always grateful to the associate editors and referees who provided valuable comments on earlier versions of these articles. I thank Editor-in-Chief Hau Lee for providing the opportunity to feature research in this area.