Editorial

Angappa Gunasekaran

Business Innovation Research Center (BIRC),
Department of Decision and Information Sciences,
Charlton College of Business,
University of Massachusetts – Dartmouth,
285 Old Westport Road,
North Dartmouth, MA 02747-2300, USA
E-mail: agunasekaran@umassd.edu

Biographical note: Angappa Gunasekaran is a Professor of Operations Management and the Chairperson of the Department of Decision and Information Science at the Charlton College of Business, University of Massachusetts, Dartmouth (USA). He is teaching undergraduate and graduate courses in operations management and management science. Gunasekaran has over 200 articles published in 40 different peer-reviewed journals. He has presented over 50 papers and published about 50 articles in conferences and given a number of invited more talks in about 20 countries. Gunasekaran is on the editorial board of over 20 journals. He is the Editor of several journals in the filed of operations management and information systems. Gunasekaran is the Director of Business Innovation Research Center at the University of Massachusetts – Dartmouth and received grants over $300,000 to support his research and other academic activities.

Welcome to the inaugural issue of *IJMOR*

I am pleased to introduce this inaugural issue of the *Int. J. Mathematics in Operational Research* (*IJMOR*). *IJMOR* proposes and fosters discussion on theory and applications of mathematics in Operations Research and Management Science techniques and models. Globalisation of markets and operations incorporating e-commerce creates a complexity in the decision-making process in terms of determining suitable criteria and trade-offs which in turn highlights the importance of mathematics in operations research and management science models and solution techniques. Now the real challenge is to make sure the application of mathematics in operations research and management science theory and applications is adequate for modelling and analysis of the so-called, 'the new economy and enterprise environment'. Mathematics in operations research and management science theory and applications should be consistent with emerging economy and enterprise environments. For example, the application of mathematics in operations research/management science for an effective optimisation of various objective functions along with appropriate criteria and constraints need to be considered in this new environment. Moreover, the application of mathematics in the determination of suitable criteria and modelling techniques for supplier selection, advertising decisions in the internet or WWW, and the development and managing of virtual enterprises that

are primarily centred on strategic alliances, core competencies and information technology/systems will be a challenge.

New mathematical theory and applications in operations research and management science models and applications will be the main focus of this journal. *IJMOR* is aimed at shaping the future of mathematics in operations research and management science theory and applications. *IJMOR* is a fully refereed journal generally covering new mathematical theory and applications in operational research and management science models and techniques for solving problems in manufacturing and service organisations. The key problem areas include marketing, design, engineering, production, logistics, procurement, finance and accounting, information systems and supply chain.

Operational research has become one of the most indispensable tools in business and military applications. Considering the advances in information technology and global operations, modelling and analysis play a major role in abstract representation of business systems and data analysis and, subsequently, in the generation of relevant information for making more accurate decisions that will support productive functioning of different systems and, in turn, the organisational competitiveness. There is a need to identify and develop suitable mathematics for developing operational research models and solution techniques taking into account the analysis of large volume of data available. This will help efficient analysis of data for obtaining accurate information to make the best decisions.

Realising the importance of mathematical theory and applications in operations research models and techniques, we felt a dedicated journal to this field is a must. The main objective of the journal is to provide a platform for interaction between researchers and practitioners in the theory and applications of mathematics in operations research and management science models and techniques. It also aims to promote and coordinate the development of mathematics in the field of decision-support systems, artificial intelligence and expert systems in new enterprise environments. *IJMOR* will provide researchers and practitioners with the state of the art of mathematical theory and applications in operations research models. The journal will act as a vehicle to help professionals, academics and researchers, working in the field of mathematical application in operations research and management science, to disseminate information and latest developments and to learn from each other's research. The journal will publish original papers, review papers, book reviews, and technical notes. Special issues devoted to important topics in mathematical perspectives of management science and operations research will be published.

This inaugural issue contains 12 articles discussing a range of issues dealing with mathematics in operations research and management science models, techniques and applications. We provide a brief overview of papers appear in this issue.

A common approach to many combinatorial problems is to model them as 0/1 linear programs. This approach enables the use of standard linear program-based optimisation methodologies that are widely employed by the operations research community. While this methodology has worked well for many problems, it can become problematic in cases where the linear programs generated becomes excessively large. In such cases, linear models can lose their computational viability. In recent years, several papers have explored the computational attractiveness of non-linear alternatives to the standard linear models typically adopted to represent such problems. In many cases, comparative computational testing yields results favouring the non-linear models by a wide margin. In their article, 'Computationally attractive non-linear models for combinatorial

optimisation', Alidaee, Kochenberger, Lewis, Lewis and Wang summarise some of these successes in an effort to encourage a broader view of model construction than the conventional wisdom, i.e. linear modelling, typically affords.

Hlynka, Hurajt and Cylwa in their article, 'Transient results for $M/M/1/c$ queues via path counting', find combinatorially the probability of having n customers in an $M/M/1/c$ queuing system at an arbitrary time t when the arrival rate λ and the service rate μ are equal, including the case $c = \infty$. Their method uses path counting methods and finds a bijection between the paths of the type needed for the queuing model and paths of another type which are easy to count. The bijection involves some interesting geometric methods.

The article, 'Investigating the benefits of re-optimisation while searching for two immobile entities on a network', by Jotshi and Batta considers the problem of searching for two immobile entities on an undirected network, where the entity locations are probabilistically known and dependent. This article extends the work by Jotshi and Batta (2008) – search for a single entity. The problem is first examined for the case where re-optimisation is not allowed. In the second case, re-optimisation is allowed after the discovery of the first entity. For both cases, the objective is to minimise the expected search time to find both entities. Heuristic algorithms are introduced and computational results are presented showing the benefits of allowing re-optimisation.

Demand of emergency materials is usually uncertain and varies quickly as the latent period changes. With the consideration of the delay caused by the latent period of an epidemic, Wang, Wang and Zeng in their article, 'Optimal material distribution decisions based on epidemic diffusion rule and stochastic latent period for emergency rescue' construct a multi-objective stochastic programming model with time-varying demand for the emergency logistics network based on the epidemic diffusion rule. The genetic algorithm coupled with Monte Carlo simulation is adopted to solve the optimisation model, and the application of the model as well as a sensitivity analysis of the latent period is given by a numerical example.

In the article, 'Valur functions and trade-offs associated with the analytic hierarchy process hierarchic composition law', Troutt, Tadisina and Pendharkar provide a fresh bridge between the original formulation of the analytic hierarchy process (AHP) and the more classical theory of value functions. They focus on the hierarchic composition law (HCL) as a device for aggregation. They derive a class of fundamental functional equations, which relate the priorities construct of the AHP to a particular value function. Their results indicate that the number of alternatives being compared in the AHP is the main cause of rank reversal. They show that different numbers of alternatives determine different trade-off curve systems, and hence necessarily, different value functions. The results obtained here establish a link between the original AHP formulation using the HCL and multi-attribute value function theory, with promise of more positive mutual benefit between the topics in the future.

Decision Trees are widely utilised to model decision analysis problems. However, a thorough study of their properties from the sensitivity analysis viewpoint has not been offered yet. Borgonovo in his article, 'Sensitivity analysis of multinational Decision Trees' first summarises recent results in the realm of constrained sensitivity analysis for formalising the local sensitivity analysis of Decision Trees. He then derives a new result that allows streamlining the differentiation of Decision Trees and obtaining derivatives at the same cost of Tornado Diagrams. He formulates a new numerical procedure and illustrates it by means of a case study. Finally, he discusses the conditions that allow

extending the results to decision-making problems represented in the form of Influence Diagrams.

The article, 'Semidefinite relaxations of the quadratic assignment problem in a lagrangian framework', by Roupin considers partial lagrangian relaxations of continuous quadratic formulations of the quadratic assignment problem (QAP) where the assignment constraints are not relaxed. These relaxations are a theoretical limit for semidefinite relaxations of the QAP using any linearised quadratic equalities made from the assignment constraints. Using this framework, they survey and compare standard semidefinite relaxations of this classical NP-hard problem. In particular, this approach is a simple way to prove that some well-known semidefinite relaxations for the QAP are equivalent. Nevertheless, these relaxations have a different numerical behavior and practical usefulness depending on the semidefinite programming solver.

The split delivery vehicle routing problem (SDVRP) relaxes the classical vehicle routing problem (VRP) by allowing multiple vehicles to supply the demand of individual customers thereby potentially reducing costs. Aleman, Hill and Zhang in their article, 'A ring-based diversification scheme for routing problems' provide an up-to-date review of the SDVRP literature and present a new solution diversification scheme based on concentric rings centred at the depot that partitions the original problem. The resulting sub-problems are then solved using a constructive approach. Different ring settings produce varied partitions and thus different solutions to the original problem are obtained and improved via a variable neighbourhood descent. Computational results on available test problems demonstrate the effectiveness of the proposed algorithm and present new best solutions to some of the tested problems.

In their article 'An accurate and efficient numerical method for solving Black-Scholes equation in option pricing', Liao and Zhu (2008) present an efficient and accurate numerical method for solving the well-known Black-Scholes equation in option pricing. The method can be used for cases in which the coefficients in the Black-Scholes equation are time dependent and no analytic solutions are available. This article is an extension to the method by Liao and Zhu (2008) for solving 1D convection-diffusion equations with constant diffusion and convection coefficients using the fourth-order Padé approximation on a three-point stencil. The new method can handle equations with variable diffusion and convection coefficients that depend on $x2$ and x, respectively, where x is the independent variable. Numerical examples are presented in the article to demonstrate the accuracy and efficiency of the method.

Probabilistic processing times, times between breakdowns, and repair times make the amount of stock in buffers between stations in production lines behave as a stochastic process. Too much, or too little, buffer stock reduces system economy and efficiency, respectively. Cochran, Kokangul and Khaniyev in their article, 'Stochastic approximations for optimal buffer capacity of many-station production lines' obtain optimum buffer capacities and initial stock levels for production lines employing a mathematical random walk approach based on the maximum and minimum values of a stochastic process in a time window. Two approximations are developed, each useful under different risk-acceptance assumptions. A motivating case study from a discrete part manufacturing line, including an example of using regression on the simulated results, is presented.

The article, 'List graph colouring for multiple depot vehicle scheduling' by Laurent and Hao addresses a multiple depot vehicle scheduling problem (MDVSP) arising in public transportation. The general problem consists in assigning vehicles to trips while

minimising the number of scheduled vehicles and the operational costs. The MDVSP considered here takes into account heterogeneous types of vehicles with complex relations among them. This special feature matches well situations encountered in practice, but makes the problem particularly difficult. They introduce a new formulation based on list graph colouring, from which an Iterative Tabu Search is developed for vehicle minimisation. The approach is assessed on seven real-world benchmarks and yields highly satisfactory results in terms of solution quality and computation time.

In their article, 'Analysis of a two-node task-splitting feedback tandem queue with infinite buffers by functional equation', Haghighi and Mishev consider a two-node single-processor Markovian tandem queuing system with task-splitting and feedback. Each node has an infinite buffer before it and, thus, no blocking is possible in the system. Splitting feature is added to the model considered and it makes it a novel tandem queue. The functional equation developed from the generating function applied to the system of difference equations is solved using Riemann–Hilbert problem. The mean of the stationary queue length at each node is found. An Algorithm is given for computation of performance measures. Using approximation, a numerical example is offered to illustrate the workability of the Algorithm.

Invitation to *IJMOR*

The development mathematical theory and applications in operations research and management science techniques and models should be tailored to the new economy and enterprise environment incorporating the advances in information technology. This poses a great challenge for the researchers and practitioners, to develop new mathematical theory and applications in operations research and management science models. Also, new programming languages such as the object oriented programming, JAVA and speed of computers. These have altered the traditional constraints present in the modelling and analysis of the optimisation problems in new economy and enterprise environments.

Int. J. Mathematics in Operational Research is a referred journal that acts as a forum for exchanging innovative ideas and sharing of research in mathematical theory and applications of management science and operations research. *IJMOR* will focus on new mathematical theory development and applications in operations research and management science. Some of the areas include: inventory models, queuing, transportation, game theory, scheduling, project management, mathematical programming, decision-support systems, multi-criteria decision making, artificial intelligence and expert systems, neural network and fuzz logic, and simulation. Articles of the following types will be considered: mathematical and simulations models, reviews on the state-of-the-art of operations research and management science theory and applications, and industry applications.

Academics and practitioners are invited to forward their contributions in the areas of mathematics in management science and operations research for possible publication in *IJMOR*. Potential editors are welcome for guest editing special issues in emerging areas of mathematics in operations research and management science. Please direct all your communication to the Editor-In-Chief (agunasekaran@umassd.edu). A global business perspective and its implications are emphasised. *IJMOR* will:

- Raise the awareness of importance of applications of mathematics in operational research and management science.
- Focus on excellence in developing mathematical theory and applications in operational research and management science techniques, models and solution methodology to solve problems in the information-intensive global society.
- Provide insights regarding the latest mathematical theory and applications in operational research and management science models, techniques and applications.
- Offer a networking forum for academics, mathematicians, operational research and management scientists and practitioners, professionals and entrepreneurs.

Readership

IJMOR is a forum to help academics and researchers, pure and applied mathematicians, practitioners, and operations and management science professionals, in all areas of engineering and business applications. It will enable academics and practitioners working in the field of applied mathematics, and mathematical theory and applications in operational research and management science, to discuss important mathematical ideas and applications, and disseminate information for mutual learning and pursue fundamental research in operational research and management science.

Contents

IJMOR publishes original papers, review papers, theory and methodology papers, industrial papers, technical notes, and book reviews. Special Issues devoted to important topics in mathematics of operational research and management science are welcome.

Subject coverage

Suitable topics include, but are not limited to:

- mathematical theory and applications in operations research
- applications of mathematics in management science
- innovative applications of mathematics in optimisation
- mathematics in developing computational theory and applications
- algorithms for efficient solution methodology
- mathematics of discrete, continuous and stochastic optimisation
- stochastic theory and models
- mathematical programming
- dynamic programming

- stochastic programming
- simulation techniques
- control theory and methodologies in operational research
- mathematical of inventory theory and models
- marketing models and optimisation
- operations research mathematics in procurement, manufacturing and distribution
- mathematical models of operations research and management in finance and accounting
- queuing theory and applications
- transportation theory and applications
- applied mathematical techniques in data mining and storage management
- location theory and applications
- artificial intelligence and expert systems
- network theory and applications
- game theory and applications
- decision theory and support systems
- reliability
- scheduling theory and applications
- statistical techniques and tools in operational research and management science
- telecommunication networks
- supply chain management modelling and analysis
- machine learning
- financial modelling and analysis.

Acknowledgements

I am most grateful to Professor Mohammed Dorgham, Dr Jeanette Brooks, Mrs Barbara Curran, Mr Jim Corlett and Ms Sue O'Mara of Inderscience Publishers Limited for their excellent professional support throughout the launch of this journal. Moreover, I would like to thank all the distinguished Editorial Board Members who are renowned for their research in the field of mathematics in operations research and management science for agreeing to serve on the board of *IJMOR*. Finally, but not the least, my sincere thanks go to all the authors of this inaugural issue for their timely contribution to realise the launch of this journal on time.

References

Jotshi, A. and Batta, R. (2008) 'Search for an immobile entity on a network', *European Journal of Operational Research*, Vol. 192, pp.347–359.

Liao, W. and Zhu, J. (2008) 'A new method for solving convection-diffusion equations', Paper presented in the Proceedings of the *11th IEEE International Conference on Computational Science and Engineering*, IEEE Computer Society, Los Alamitos, CA, USA, pp.107–114.