

# Editorial

This first issue of ORiON Volume 25 contains six interesting papers, again spanning a substantial portion of the wide operational research spectrum, from practical studies to the establishment of new theoretical results.

In the first paper, titled *An easy and low cost option for economic statistical process control using Excel*, Pieta van Deventer and Zerai Manna develop a user-friendly worksheet implementation in Microsoft Excel to find parameter values that minimize the total cost function in both economic and economic statistical designs of the  $\bar{X}$ -control chart under the two important assumptions that the time between process shifts can be modelled by means of an exponential distribution, and that there is only one assignable cause. The approach in this paper is novel for two reasons: (i) Traditionally, practitioners do not attempt to optimize the design of their  $\bar{X}$ -control charts (because the cost models and their associated optimization techniques are often too complex to understand and apply in industry), and (ii)  $\bar{X}$ -control charts are usually implemented in either an economic or statistical paradigm (not both) — but in this paper the authors unify these distinct traditional approaches into a single economic statistical paradigm. The optimization procedure described in the paper is easy-to-use, easy-to-understand, easy-to-access, and is illustrated by means of a number of numerical examples. Furthermore, the contribution of this paper is made particularly practical in the appendix to the paper by the inclusion of a detailed description of the Excel worksheet in which the approach of the paper has been implemented, and this worksheet is available from the authors upon request.

Drug resistance to single therapeutic treatment in HIV infected individuals has promoted research into combined treatments. In the second paper, titled *A stochastic model of the dynamics of HIV under a combination therapeutic intervention*, Sarma Yadavalli, Oreoluwapo Lebeodan, Swaminathan Udayabaskaran and Yeko Mwangi propose and analyse a stochastic model for the effect of combined therapeutic treatment by extending a previous model of HIV pathogenesis under treatment by anti-viral drugs of Perelson *et al* [2]. Using this extension, the authors are able to obtain variance and co-variance structures of variables in addition to the mean numbers of free HIV, infectious free HIV and non-infectious free HIV that were obtained by Perelson *et al*. The advantage of this modelling approach is demonstrated at the end of the paper in a series of numerical results obtained by solving the model for before and after treatment scenarios.

The third paper, by Daniel Akume, Bernd Luderer and Ralf Wunderlich titled *Optimal portfolio strategies under a shortfall constraint*, introduces a novel, dynamic shortfall constraint in terms of tail conditional expectation into a traditional modelling environment for the portfolio selection problem in continuous time. The authors use the resulting model to obtain optimal investment strategies. The financial market is assumed to comprise  $n$  risky assets driven by geometric Brownian motion and one risk-free asset (a bond). The method of Lagrangian multipliers is combined with the Hamilton-Jacobi-Bellman equation to insert the constraint into the resolution framework (the constraint is re-calculated at short intervals of time throughout the investment horizon). A numerical method is employed to solve the model approximately, and the authors find that the imposition of this new constraint is able to curb investment in risky assets.

Readers residing in the Western Cape may have noticed extensive road works in and around the City of Cape Town in preparation for the 2010 FIFA World Cup Tournament. In the fourth paper in this issue, titled *Mathematical principles of road congestion pricing* Wessel Pienaar and Hannelie Nel identify prerequisites to the successful application of a road congestion pricing scheme. The paper is divided into two sections. The first section contains a mathematical analysis of the constituents of an optimal road congestion price. The eliminated inefficiency loss achieved by the introduction of a congestion levy is usually evaluated by means of an integral involving marginal trip cost, travel demand and average trip cost in two-dimensional (travel time, traffic flow)-space. However, the authors show that this loss may, in fact, be evaluated much more easily for a general marginal trip cost function and a linear demand function as the difference between the areas of a rectangle (representing that part of road agency revenue that lies below the original trip cost) and a triangle (representing the loss of consumer surplus of the reduced traffic) in (travel time, traffic flow)-space, thereby eliminating the need to use integration altogether. In the next section the authors illustrate the application and workability of the mathematical principles described in the first section with respect to a hypothetical case study relating to road congestion pricing for the ten kilometre stretch of the N1 highway between the Heerengracht-Table Bay Boulevard intersection and the Wingfield Interchange — one of the road sections currently subjected to extensive road works.

Research into management interventions that create the required enabling environment for growth and development in South Africa is very topical in the current political landscape of renewed efforts with respect to accountable governance. In the penultimate paper of this issue, titled *A resource allocation model to support efficient air quality management in South Africa*, Urishanie Govender and Jan Kruger investigate the level of efficiency of the Air Quality Units within the three spheres of government *viz.* National, Provincial, and Local Departments of Environmental Management in South Africa, with the view to develop a resource allocation model capable of optimizing this efficiency. The inputs to the model were calculated from the actual man-hours spent on twelve selected activities relating to project management, knowledge management and change management. The outputs assessed were aligned to the requirements of the mandates of the three spheres of government according to the Air Quality Act of 2004 [1]. Several models were explored using multiple regression and stepwise techniques. The model that best explained the efficiency of the organisations from the input data, namely logistic regression analysis, was selected. The authors use this model to predict the required resources per Air Quality Unit in the different spheres of government, in an attempt at supporting and empowering the air quality regime to achieve improved output efficiency.

Backpropagation learning is a popular method for determining optimal weights between different interconnected layers of neurons in a feedforward neural network. This learning procedure typically applies a gradient descent technique in order to minimise some error function (usually a sum of squared differences between observed and desired outputs over some training set of input-output pattern pairs). The first derivatives of the error with respect to the weights identify the local error surface in the descent direction, *i.e.* the network exhibits a different local error surface for every different pattern presented to it, and weights are normally modified in an iterative fashion in order to minimize the current local error. However, the determination of an optimal weight vector is possible only

when the total minimum error (mean of the minimum local errors) for all patterns from the training set may be minimised. In the penultimate paper of this issue, titled *Conjugate descent formulation of backpropagation error in feed forward neural networks*, Naveen Sharma, Sanjeev Kumar and Manu Singh present a general mathematical framework for the incorporation of the second derivative of the error function with respect to the weights (*i.e.* a conjugate descent) into arbitrary feedforward neural network topologies. The authors then use this derivative information to achieve enhanced convergence of the network weights when compared to the standard gradient descent approach. They present some numerical evidence of the superior convergence claimed in the context of five handwritten text character recognition problems.

I trust that the diversity and quality of the six papers in this issue are such that each reader of ORiON will find something suiting his/her particular tastes and interests. Suggestions and comments on publications in ORiON, in the form of letters to the editor, are welcome and may be published in future issues of the journal.

I would like to thank the sixteen authors who have contributed their interesting work to Volume 25(1) of ORiON. My sincere thanks also go to the thirteen anonymous referees who have generously given of their time to evaluate the papers in this issue timeously and in a very professional manner; their excellent work has led to substantial improvements in the quality of papers in virtually all cases.

ORiON has been in existence since 1985; therefore 2009 is the quarter centennial of the journal. It is my privilege to announce that we are planning to celebrate this special occasion by dedicating Volume 25(2), due out in December 2009, as a special birthday issue containing invited contributions in the form of surveys of literature under the general issue theme of “Recent advances in ...” by highly respected, international operations researchers. These contributions will be refereed in the usual manner, and as a birthday present to the journal, the levels of citation of the invited authors is expected to raise overall citations of ORiON.

The editorial office is also planning to launch an online submissions system for ORiON. We are currently subjecting the system to extensive testing before it goes live. The system is expected to be fully operational towards the end of 2009 and will hopefully render the process of manuscript submission and the subsequent management of the review process of manuscripts significantly easier and more transparent for authors, reviewers and editors.

Finally, my sincere thanks go to Martin Kidd, new editorial assistant, who assumes much of the administrative duties involved in managing the submission and refereeing processes of manuscripts on my behalf. I would also like to thank the business manager, Stephan Visagie, and his typesetting assistant, Lieschen Venter, for their high standards and considerable patience during the often exhausting typesetting process of manuscripts in  $\text{\LaTeX}$ , and for overseeing the time-consuming publication process of this issue.

Jan van Vuuren  
June 2009

## References

- [1] AIR QUALITY ACT, 2004, South Africa, [Statute], Government Gazette, **476**, Pretoria, pp. 121–122.
- [2] PERELSON AS, NEUMANN AU, MARKOWITS M, LEONARD JM & HO DD, 1996, *HIV-1 Dynamics in vivo virion clearance rate, infected cell lifespan, and viral generation time*, Science New Series, **271**, pp. 1582–1586.