

# *Editorial*

This first issue of ORiON Volume 26 contains five interesting papers. These papers yet again span a substantial portion of the wide operational research spectrum, as we have become accustomed in ORiON.

In the first paper, titled *Solving the extended tree knapsack problem with fixed cost flow expansion functions*, David van der Merwe and Giel Hattingh develop a number of partitioning algorithms which use standard off-the-shelf optimisation software (CPLEX) coupled with enhanced modelling techniques (the inclusion of valid inequalities) to solve the *extended tree knapsack problem* (ETKP) with fixed cost flow expansion functions. The significance of this work is that parts of the celebrated *local access telecommunication network* (LATN) planning problem may be modelled as an ETKP and that the LATN infrastructure may contribute as much as 60% of the total network costs. Enhancements to the algorithms are described in detail before the authors test their algorithms empirically for both the classical tree knapsack problem and the ETKP. They find that their algorithms solve the test instances faster and with less variation in solution time than does the off-the-shelf optimisation software on its own.

The French-born economist and mathematician Gérard Debreu [1] established sufficient conditions for the existence of a continuous utility function in 1954. Ten years later he discovered an error in his original proof of this existence result, and corrected this error in his 1964 paper [2] by proving what is now known as his *Gap Lemma*. The proof of this lemma is usually omitted from standard textbooks on utility theory, because of its length and complexity. However, in the second paper of this issue, titled *A simple proof of Debreu's Gap Lemma*, Peter Ouwehand proposes an elegant new proof of Debreu's Gap Lemma. This novel proof is based on standard textbook constructions of utility functions on countable linearly ordered sets and is accessible to students with limited mathematical background, hence making it ideal for inclusion in elementary texts on utility theory.

In the third paper, titled *Modified strip packing heuristics for the rectangular variable-sized bin packing problem*, Frank Ortmann and Jan van Vuuren consider two packing problems, namely the well-known *strip packing problem* (SPP) and the *variable-sized bin packing problem* (VSBPP). They review a total of 252 heuristics (and variations thereof) from the literature, and propose a number of novel heuristics for the SPP, before comparing all of these algorithms statistically by means of 1170 SPP benchmark instances in order to identify the best heuristics in various classes. They find that a combination of their new heuristics with a new sorting method yields the best results. These heuristics are then combined with a previous heuristic for the VSBPP by the same authors to find good feasible solutions to 1357 VSBPP benchmark instances. This paper contains, to the best knowledge of the authors, the largest statistical comparison of algorithms for the SPP and the VSBPP to date.

Traditional approaches towards determining the *economic production lot* (EPL) size in manufacturing applications assume deterministic demand, often at a constant rate. However, in the penultimate paper of this issue, titled *A Markov decision model for optimising economic production lot size under stochastic demand*, Paul Mubiru develops an optimisation model for determining the EPL size that minimises production and inventory costs

of a periodic review production-inventory system under stochastic demand, assuming that production decisions may influence the demand during later time periods. Adopting a Markov decision process approach, where the states of the Markov chain represent possible states of demand, an optimal periodic decision of whether or not to produce additional inventory units is found by means of dynamic programming. Using this approach, the author is able to establish an optimal state-dependent EPL size as well as the corresponding minimum total production and inventory costs.

The overall availability of the various components that make up a chemical process is of critical importance in the petro-chemical industry. The final paper of this issue, titled *Simulation experiments for maximising the availability of a commercial octene production facility*, contains an evaluation by Ruan Rossouw, Roelof Coetzer and Phillip Pretorius of the process design factors that influence the availability of a new chemical production facility. This evaluation is carried out by performing computer experiments on a stochastic simulation model of the working of the facility. Experimental designs commonly used in the theories of the *design and analysis of computer experiments* and the *classical design of experiments* are evaluated and compared for this application. The authors also evaluate the resulting response surface and kriging models with respect to their ability of approximating the relevant input-output relationships. They use the most accurate experimental design by approximation model combination to explore the design space, both in terms of the overall availability and the percentage time offline of the facility, and finally illustrate how the design and analysis of simulation experiments may be used to minimise the risks in the design of the production facility (in terms of maximising the overall availability and minimising the percentage time offline simultaneously).

As always, I trust that the diversity and quality of the five 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 nine authors who have contributed their interesting work to Volume 26(1) of ORiON. My sincere thanks also go to the eleven 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. Last, but not least, I would like to thank associate editor John Hearne for managing the review process of one of the papers in this issue on my behalf, so as to avoid a conflict of interest.

The editorial office has recently launched a test-version of ORiON's new online submissions system. The system has been subjected to extensive in-house testing, is currently fully operational 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. Authors of new submissions are currently being asked to submit their manuscripts via the test version of this online system so as to help us complete the testing phase. Once testing of the system has been completed, it will be rolled out on the ORiON page of the ORSSA webpage, at <http://www.orssa.org.za/> → ORiON.

Finally, my sincere thanks go to Martin Kidd, editorial assistant, who continues to assume

much of the administrative duties involved in managing the submission and review processes of manuscripts. I would also like to thank the business manager, Stephan Visagie, and his new typesetting assistant, Anton de Villiers, for their high standards and considerable patience during the often exhausting typesetting process of manuscripts in L<sup>A</sup>T<sub>E</sub>X, and for overseeing the time-consuming publication process of this issue.

Jan van Vuuren

June 2010

## References

- [1] DEBREU G, 1954, *Representation of a preference ordering by a numerical function*, pp. 159–165 in THRALL R, COOMBS CC & DAVIS R (EDS), *Decision processes*, Wiley, San Francisco (CA).
- [2] DEBREU G, 1964, *Properties of Paretian utility*, International Economic Review, **5**, pp. 285–293.