

# Editorial

This first issue of ORiON Volume 24 contains five interesting papers, spanning the operational research spectrum, from practical (special case) studies to theoretical results and the development of new methodology.

In the first paper, titled *On the efficient solvability of a simple class of knapsack problems*, Stephan Visagie considers the question of whether it is possible to design an efficient algorithm for solving (to optimality) the class of nonlinear knapsack problems where the objective function is separable into a sum of increasing convex functions and a sum of increasing concave functions (of budget allocation variables). The author shows that it is, in general, possible to encounter an arbitrarily large number of candidate solutions for which necessary conditions for local optimality hold and that no sufficient conditions for global optimality can be derived from the existing theory on nonlinear programming. He then suggests an algorithm utilising the necessary conditions for local optimality to limit a search through the solution space for a global optimum. However, for some problem instances the runtime of the algorithm may be substantially longer than that of a standard branch-and-bound approach (with linear enveloping), rendering the approach inefficient. The author finally argues that, barring a break-through in the general theory on nonlinear programming, one essentially cannot do better than to adopt a customised branch-and-bound approach to solve this particular class of knapsack problems.

The second paper, by Frans van den Berg, Jenny Holloway, Mark Pienaar, Renee Koen, Chris Elphinstone and Stephan Woodborne titled *A comparison of various modelling approaches applied to Cholera case data*, is an exploration of the application of spectral methods for informing the development of statistical forecasting models. The exploration takes the form of a cholera epidemic case study. The seasonal behaviour of the target variable (cholera cases) is analysed using singular spectrum analysis, followed by spectrum estimation via the maximum entropy method. This seasonal behaviour is compared to that of environmental variables (such as rainfall and temperature). The spectral analysis is then refined using a cross-wavelet technique, which is used to compute lead times for co-varying variables. Several statistical modelling techniques, including generalised linear models, ARIMA time series models, and dynamic regression are finally investigated with a view to developing a cholera cases forecast model fed by environmental variables. The analyses are based on real data collected in Beira, Mozambique. The authors find dynamic regression to be the preferred forecasting method for their data set.

The third paper, titled *A minimum incoming weight label method and its application in CPM networks* by Elias Munapo, Brian Jones and Santosh Kumar, contains a description of an efficient approach towards finding shortest paths from the source to all other nodes in an acyclic, directed network containing exactly one source and one sink (this kind of network typically arises in project scheduling applications, and the objective of seeking shortest paths may easily be converted to the objective of seeking longest or critical paths). The algorithm runs in  $\mathcal{O}(n)$  time after having found a topological sort for a network comprising  $n$  nodes, and the approach is based on a simple minimum incoming weight labelling method. Although many shortest path algorithms exist in the operational research literature, the method described in this paper lends itself readily to determining

optimal crash limits for various activities in project scheduling applications. In cases of network topology change (*e.g.* when an activity has to be completed in crash duration or the actual duration of an activity takes longer than scheduled), new critical paths and new associated floats may be computed without analyzing the complete network all over again. The algorithm is illustrated by means of a numerical example.

Gender remuneration inequalities at universities have been studied by various authors. In South Africa, the responsibility largely rests with individual higher education institutions to establish their own remuneration levels for male and female members of the academic staff. The multidimensional character of the resulting gender wage gap typically includes gender differentials in research output, age, academic rank and qualifications. In the penultimate paper of this issue, titled *Monitoring gender remuneration inequalities in academia using biplots*, Idielle Walters and Niël le Roux demonstrate the use of modern biplot methodology (a multivariate extension of the notion of a scatter plot) for describing and monitoring changes in the gender remuneration gap over time. They apply this methodology in a special case study involving permanent fulltime academic staff at Stellenbosch University (SU), South Africa over the period 2002–2005. The resulting biplots illustrate clearly that rank, age, research output and qualifications are related to remuneration levels at SU over the study period. It is interesting to see how the use of biplots may facilitate the identification of narrowing, widening or constant gender remuneration gaps in the various faculties at SU.

In the final paper, titled *Real-time threat evaluation in a ground based air defence environment*, Jaco Roux and Jan van Vuuren present a number of ideas with respect to the design of a decision support system (DSS) for threat evaluation of fixed wing aircraft in a ground based air defence (GBAD) environment. GBAD operators are typically required to evaluate a tactical situation in real-time with the objective of protecting own-force defended assets on the ground against radar-observed aerial threats by assigning available weapon systems to engage enemy aircraft. Since this GBAD environment requires rapid operational planning and decision making in stress situations, the associated responsibilities are usually divided between a number of operators and computerized systems that aid these operators during their decision making processes. In particular, the DSS in question aids these operators in assigning threat values to aircraft (with respect to defended assets) in real-time and uses these values to propose possible engagements of observed enemy aircraft by anti-aircraft weapon systems. The DSS design follows the structured approach suggested in [ROUX JN & VAN VUUREN JH, 2007, *Threat evaluation and weapon assignment decision support: A review of the state of the art*, ORiON, **23(2)**, pp. 151–187], phasing in a suite of increasingly complex qualitative and quantitative model components as more (reliable) data become available.

As always, I am confident 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.*

This issue also sees the introduction of a newly appointed high-profile, international Advisory Board for ORiON. It will be the responsibility of the Advisory Board to advise the editors with respect to standards on a post-publication basis, and to assist in resolving ref-

ereeing disputes (on a pre-publication basis) in their respective fields of expertise. I would like to thank the fourteen board members for their willingness to assist in the management of ORiON in this capacity on a voluntary basis amid severe pressure of work.

I would like to thank the fourteen authors who have contributed their interesting work to Volume 24(1) of ORiON — the readership of ORiON are encouraged to continue utilising the journal as publication vehicle for their research. My sincere thanks also go to the ten anonymous referees who generously gave of their time to evaluate the papers in this issue timeously and in a very professional manner; they have made invaluable suggestions that have led to substantial improvements in the quality of papers in virtually all cases.

My thanks also go to Adri van der Merwe, editorial assistant, who continues to make my life considerably easier by assuming much of the administrative duties involved in managing the submission and refereeing processes of manuscripts — thereby freeing me to focus my time and efforts on the identification of appropriate referees, on issues surrounding publication decisions and on high-level strategizing for the journal. I would also like to thank Philip Fourie who has assisted me with meticulous proofreading of the papers contained in this issue — his time and expertise are much appreciated. Thank you also to Associate Editor John Hearne for managing the refereeing process of the last paper in this issue so timeously and professionally on my behalf. Finally, I would like to thank the business manager, Stephan Visagie, together with his typesetting assistant, Lieschen Venter, for their high standards and considerable patience during the typesetting process of the 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  
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