

Editorial

This second issue of ORiON Volume 21 contains seven interesting operational research papers ranging from applications in election seat allocation and image recognition to applications in inventory theory and the wood pulping industry, utilising a wide variety of operational research techniques from methodologies as diverse as mathematical programming, canonical variate analysis, reliability theory, inventory theory, multicriteria decision analysis and soft systems.

In the first paper of this volume, titled *Fairness of seat allocation methods in proportional representation*, Liezl van Eck, Stephan Visagie and Hennie de Kock analyze the fairness of a number of seat allocation methods, including the highest average methods of d'Hondt and Sainte-Laguë, and a number of largest remainder methods with various quota types. They use as performance measure the number of lost seats (votes not used to allocate seats) that result from an allocation method, which may be viewed as a discretization process, from the essentially continuous voting results (due to the very large volumes of data involved) to the discrete number of seats allotted to each party in the legislature. They compare the results of these methods against those of three new mathematical programming approaches towards minimising the deviation between the actual percentage of votes received by a party and the percentage of the total number of seats that the party receives, by applying all the methods to the 1999 and 2004 South African national election data sets. Their findings are that the number of lost votes increases as the number of parties participating in the elections increases (a worrying result for South Africa!), and that the largest remainder method with a Hare quota outperforms the seat allocation method currently in use in South Africa.

The second paper, by Sugnet Gardner, Niël le Roux, Tim Rypstra and Jan Swart titled *Extending a scatterplot for displaying group structure in multicariate data: A case study*, contains an alternative to canonical variate analysis (CVA) and multivariate analysis of variance (MANOVA) techniques that is especially suitable in cases where small sample sizes and heterogeneous co-variance matrices are encountered. The authors argue that an analysis of distance (AOD) analogous to an analysis of variance may be performed in conjunction with biplots in such cases. They demonstrate the use of AOD in a case study from the South African wood pulp industry and show convincingly how AOD is a viable alternative to CVA and MANOVA in cases where a primary product (such as wood), influenced by several variables (such as height growth, wood density, total pulp yield, alkali consumption and tensile energy absorption), is produced and where this product is of importance to various secondary manufacturers (such as producers of kraft liner or sack paper), depending on which set of multidimensional specifications are met.

In the third paper, titled *A filter bank for rotationally invariant image recognition*, Sittisak Rodtook, Stanislav Makhonov and Edmond Vanderperre introduce new rotation moment invariants, based on the multiresolution pyramid scheme in conjunction with fuzzy C-mean clustering, which may be used very profitably in automated image recognition. The image recognition rates obtained by means of these new invariants compare very favourably to results obtained by means of standard invariants, such as the Zernike moments, the Fourier-Mellin moments and a number of wavelet-based schemes. In fact, the authors

demonstrate, by testing their approach on a large database of more than 30 000 aircraft and typographical character images, a tangible accuracy increase of between 3% and 15% when measured against some of the best techniques previously available, depending on the level of noise present in the images.

The fourth paper by Sarma Yadavalli and Marina Muller, titled *A stochastic model for an urea decomposition system*, is a case study of the reliability (measured as the availability) of a technical system in the fertilizer process industry. After describing the complex process of urea decomposition (comprising a number of chemical subprocesses), the authors apply flow balance techniques to formulate a mathematical model from which they derive an expression for the probability that the system will be up and running over a long period of time at 1% and 5% levels of significance. They illustrate their results by means of a numerical example.

The fifth paper of this issue, titled *A Sokhotski–Plemelj problem related to a renewable T-cell*, contains an analysis by Edmond Vanderperre of the long-run availability of a T-cell (a technical industrial device that requires human inspections and repairs, if necessary). The analysis is stochastic and involves stationary measures satisfying Hokstad-type differential equations. All statistical distributions employed in the analysis (such as those for the failure-free time and the repair time) are assumed to be general. The author estimates the long-run availability of the device by invoking results from the theory of sectionally holomorphic functions and demonstrates his results by considering the special case of Coxian inspections as an example.

In the penultimate paper of this volume, titled *A two-commodity perishable inventory system*, B Sivakumar, N Anbazhagan and Gunaseelan Arivarignan analyze a stochastic inventory system at a service facility, where customers in a finite waiting room are serviced by means of two substitutable, perishable commodities — after some random delay. The authors derive the probability distribution of the number of customers in the waiting room under the assumption of a joint, continuous review reordering policy with random lead time. They also derive a number of performance measures for the system, such as mean inventory level, mean reorder rate, mean bulking rate, mean perishable rate, mean waiting time and expected total cost rate. Finally they illustrate their results by means of a numerical example.

The final paper of this issue, titled *Unpacking developmental local government using Soft Systems Methodology and MCDA tools* by Leanne Scott, contains a convincing argument for and a lucid description of how Soft Systems Methodology may be used to provide a context within which community needs may be considered and prioritized with a view to poverty eradication and general upliftment. These community needs, having been identified by means of MCDA techniques, may then be assessed by local government when it decides what it aims to do and what it is able to do in order to address the needs of the community (in terms of budget expenditure). The general exposition is then concluded by a very practical demonstration of how the approach described in the paper may be applied in practice, in the form of a special, hands-on case study at the small South African Western Cape community of Pniel.

I am confident that the diversity and quality of the seven papers in this issue are such that each reader of ORiON will find something interesting in this issue, suiting his/her particular tastes.

I would like to thank the sixteen authors who contributed their interesting work to Volume 21(2) of ORiON — their support of ORiON is invaluable — the readership of ORiON are encouraged to continue utilising ORiON as publication vehicle for their research. My sincere thanks also go to the thirteen 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 valuable suggestions which have led to a substantial improvement in the quality of papers in virtually all cases. Finally, I would like to thank the business manager, Stephan Visagie, for typesetting the manuscripts in L^AT_EX and for overseeing the time-consuming publication process of this issue.

Jan van Vuuren
December 2005