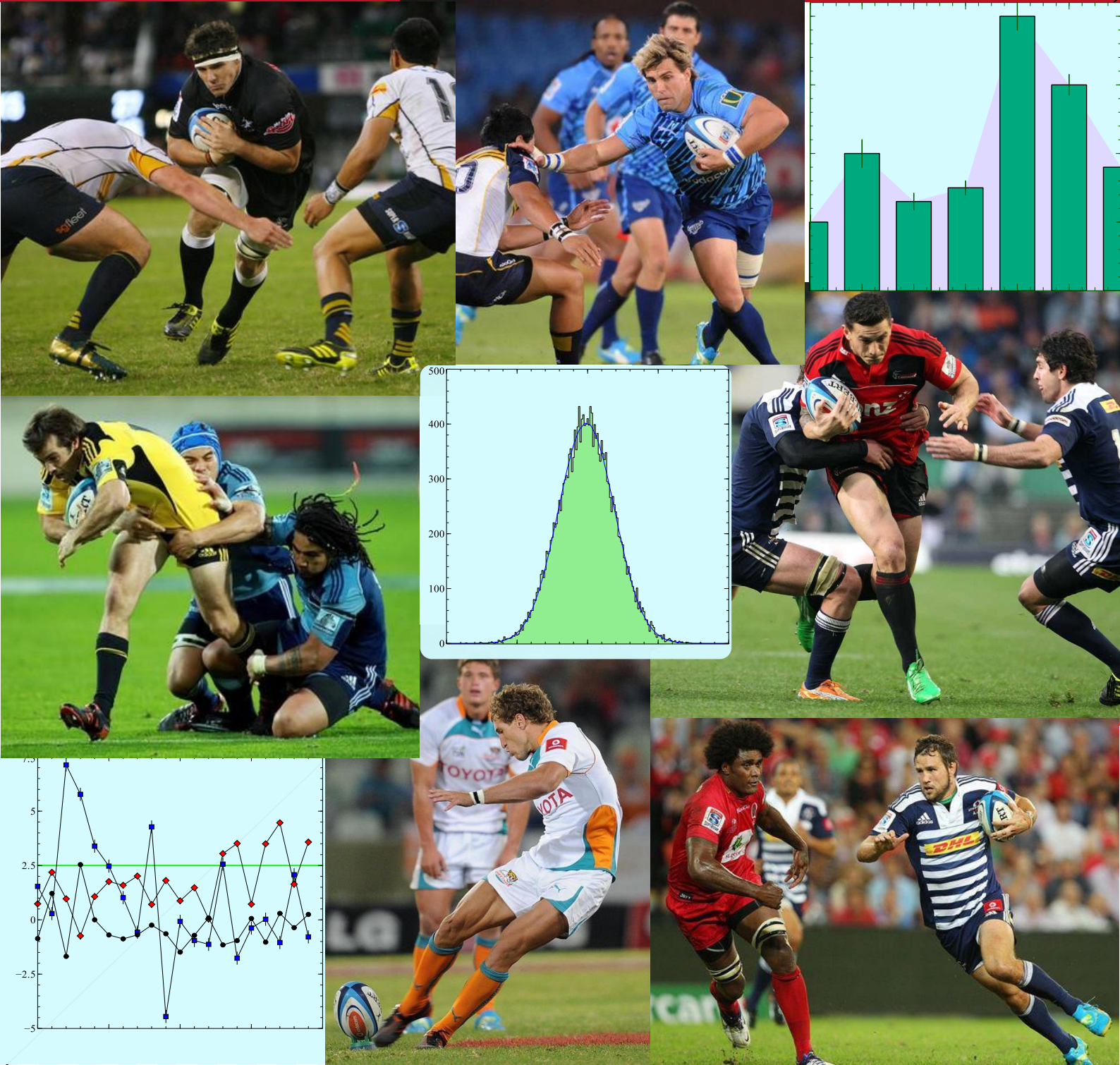




Newsletter

Operations Research Society of South Africa
Operasionele Navorsingsvereniging van Suid-Afrika



June 2012
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FROM THE EDITOR

Contactable at: 14854937@sun.ac.za



Mark Einhorn

Hello to all ORSSA members! Gosh, can you believe we are almost half way through the year already? I hope it has been a productive and successful first half for all of you thus far, and that this may continue into the fast-approaching second half.

This particular edition of the Newsletter features some truly interesting reads. The feature article is written by Jon Calder and Ian Durbach. It describes the application of multi-criteria decision analysis in the evaluation of rugby players and is a must read for any OR and/or sports enthusiast. Interestingly enough, it was inspired by a technique employed by a Major League Baseball team in the USA, the true story of which has been made into a highly successful film entitled *Moneyball*, which I would also recommend watching.

The member interview is with Angela Rademeyer who works for OPSI Systems, a company which specialises in vehicle routing and logistics management software. Angela provides some interesting information regarding the application of OR in industry.

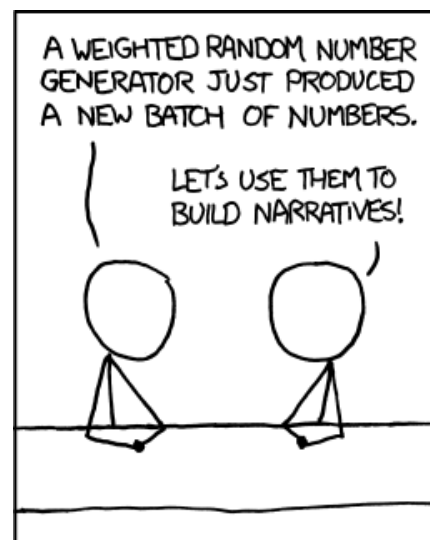
The Newsletter concludes with another very interesting book review by Hans Ittmann which deals with the fair partitioning of seats in government according to the number of votes cast.

While searching for where OR is making news around the world I came across several very interesting OR-themed blogs. The first is called *Punk Rock Operations Research* (<http://punkrockor.wordpress.com/>) and deals with the application of OR to fun and interesting (but not necessarily important) problems. The second is *Michael Trick's Operations Research Blog* (mat.tepper.cmu.edu/blog) and deals with current applications of OR in industry. Finally there's *GreenOR* (<http://greenor.wordpress.com/>) which focuses on the intersection between OR and sustainability. That's all from me for now! Cheers all and enjoy the read!

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QUERIES AND CONTRIBUTIONS

Any queries and contributions to the newsletter are most welcome, especially article submissions. For any queries or contributions, please contact the newsletter editor: Mark Einhorn
Email: 14854937@sun.ac.za



ALL SPORTS COMMENTARY

www.xkcd.com



FROM THE PRESIDENT'S DESK

by Jan van Vuuren (vuuren@sun.ac.za)

ORSSA President



Jan van Vuuren

I trust that our members have enjoyed a productive year so far with lots of stimulating and inspired operational research work in your various environments. I hope to see many of you at our annual conference (to be held during the period of 16-19 September at the Aloe Ridge Hotel, north west of Johannesburg), and to hear there about your operational research activities over the past year. Preparations for the conference are progressing well. Members may find detailed information on the relevant due dates as well as instructions for paper submission, delegate registration, fees and accommodation booking on page 13 of this newsletter or the website of the Society (www.orssa.org.za), by clicking on ORSSA 2012 in the navigation toolbar to the left of the screen. In addition to being the highlight on the operations research calendar from the point of view of networking and coming up to speed with the latest work and trends in our profession, the annual ORSSA conferences have also become known for their thoroughly enjoyable social programmes as well, and this year will be no exception. The Aloe Ridge Hotel is one of Sol Kerzner's early hotels and is uniquely situated in a nature reserve close to the Cradle of Humankind. Apart from the social events organized as part of the conference proper (such as the conference banquet), delegates will also have the opportunity to participate in various activities in the beautiful natural surroundings, such as game drives, boat trips on the river, hiking and fishing, to name but a few!

This year our keynote speaker at the conference will be professor John Hearne of the School of Mathematical and Geospatial Sciences at the Royal Melbourne Institute of Technology. John will be delivering both the opening and closing conference plenary lectures on the fascinating topics *Spatial Problems in Managing Land for Habitat and Fire* and *Conservation and Commercial Utilisation of Wildlife*, respectively. We have already

received many abstracts and delegate registrations for what promises to be a great conference!

The Executive Committee of the Society continues to work hard so as to ensure that the Society provides a service of high quality to its members. I would like to thank all the members of the Executive Committee for the commitment of their volunteer work for the Society amidst pressures of other work. These pressures can be very severe indeed. Unfortunately, Jason Matthews resigned as our Webmaster in March citing such pressure of work as the reason for his resignation. I would like to thank Jason for his services to the Society and wish him all the best. The Executive Committee has co-opted Niel Matthee (15064166@sun.ac.za) as Webmaster in Jason's stead with immediate effect. Welcome to the Executive, Niel! I trust that you will have an enjoyable and fruitful association with the Committee.


The Executive is planning to introduce a number of new initiatives about which we shall inform members at the AGM (to be held at our annual conference in September). Let me mention just two of these initiatives as examples here. The first is that we plan to introduce a new portfolio into the Executive Committee, namely a portfolio dedicated to the marketing of OR and of ORSSA. This marketing portfolio will require a slight change to our Constitution and will be responsible for marketing outreaches to schools as well as seeking to secure sponsorships for the various activities of the Society by external companies, and to establish relationships between ORSSA and a number of government agencies and departments. The second initiative is the introduction of medals for the winners of both the 4th year/honours and masters categories of our national student competitions. We also plan to maintain halls of fame for these medals (similar to that for the Tom Rozwadowski medal, which may be found on the ORSSA website by clicking on Awards in the navigation toolbar to the left of the screen). It is our hope and intention that these medals will grow in stature and prestige over the years.

I am happy to report that our chapters seem to be alive and organising interesting OR-related events. The chapter chairpersons will report back at the AGM in September on the events held in the various chapters during the course of this year. I recently attended a

hands-on workshop on the use of AIMMS (a software modelling and optimisation infrastructure suite which may be linked to commercially available off-the-shelf optimisation software packages, such as Lingo or C-Plex). This informative workshop was organized by the Western Cape Chapter of our Society. I would like to thank our chapter chairpersons for their continued efforts to organise interesting OR-related events for our members. I also invite the members of the various chapters to contact your chapter representatives (whose details may be found on the ORSSA website by clicking on Executive Committee in the navigation toolbar to the left of the screen) if you have any ideas for future chapter events.

Let me close by reiterating that our members continue to do meaningful and topical operational research work to the benefit of our country. As just one example of this, one of our Society's founding members, Dave Masterson, is currently involved in an interesting project related to the building of the new nuclear power plants announced by Eskom. The locations earmarked for these power stations are coastal sites, and a headache associated with building a nuclear power plant on the coast is what to do with all the sea sand that will be excavated in the process. On the other hand, the serious levels of sand erosion on many South African beaches has highlighted an urgent demand for such excess sea sand. Dave has undertaken to inform us in a future issue of this newsletter about how operations research can help to balance this excess supply of and urgent demand for the precious natural resource of sea sand!

As always, I would like to extend an invitation to our members to contact me at the email address above if you have any ideas for improving the quality of the service that ORSSA provides to its members that you would like to see implemented.



INFORMATICS RISING

INFORMS Annual Meeting 2012
14-17 October 2012, Phoenix AZ, USA
meetings2.informs.org/phoenix2012

Phoenix, a cosmopolitan city in the heart of the desert Southwest, looks forward to hosting you as the **OR/MS global community comes together to share its latest developments**, renew old relationships and make new friends.

The theme of the meeting, **INFORMATICS RISING**, blends the growing role of OR/MS techniques for understanding natural and artificial systems and coupling with computing and communication technologies to drive decision making for enriching our personal lives and enhancing our professional activity. Through talks, panels and tutorials, experts from academia, industry and government will present recent developments and opportunities in key thematic areas including healthcare delivery, security, global enterprise, sustainability and education as well as the underlying tools of the profession.

Brain Teaser

This problem can be solved by pre-school children in five to ten minutes, by programmers in an hour and by people with higher education... well, check it yourself!

8809 = 6	5555 = 0
7111 = 0	8193 = 3
2172 = 0	8096 = 5
6666 = 4	1012 = 1
1111 = 0	7777 = 0
3213 = 0	9999 = 4
7662 = 2	7756 = 1
9313 = 1	6855 = 3
0000 = 4	9881 = 5
2222 = 0	5531 = 0
3333 = 0	2581 = ???

Solution on page 12

Evaluating the Relative Performance of Rugby Players Using Multi-Criteria Decision Analysis

by Jon Calder and Ian Durbach

Department of Statistical Sciences, University of Cape Town, South Africa

In 2008 a member of the technical staff at the Stormers rugby team approached us with a large dataset and a question: was it possible to use the data to evaluate the players and to identify “undervalued” players? This article briefly describes our approach to addressing this question.

Most professional rugby teams collect an *enormous* amount of performance data. The primary source is a detailed event log for each game, captured from recorded match footage by a third-party. The data includes a large variety of activities for players involved in rucks, mauls, kicks, tackles, passes, etc. Data for each match consists of a list of around 6000 time-stamped events, each coded by type and player. Over 400 event types are specified, ranging from very rare events such as red cards to very frequent events like tackles. Our data is drawn from the 2008 and 2009 Super Rugby tournaments. At that time, there were 14 teams participating in the tournament – four Australian, five New Zealand, and five South African. The data included 18 pre-season games and 188 tournament games.

When evaluating relative performance, comparisons should only be made between players in similar positions. Attempting to directly compare the performance of a big strong forward with a small and speedy back is dubious, since these players each contribute different skills and abilities. We thus grouped positions with similar roles, giving 7 groups of players (props, hookers, locks, loose-forwards, half-backs, centers, and outside-backs). We then identified the criteria by which players' performances should be evaluated. This crucial choice was primarily based on previous work in the area of performance evaluation in rugby [2] and the availability of reliable data, aided by some discussion with a rugby analyst. The attributes were arranged into running, kicking, discipline, general play, breakdown involvement and special/other categories.

In assessing the relative performance of a player a_i , perhaps the simplest model is given by

$$U(a_i) = \sum_{j=1}^J w_j u_j(Z_{ij}).$$

Here w_j is a weight expressing the relative importance of changes in attribute j , and u_j is a utility (or value) function which transforms the raw attribute evaluations Z_{ij} into “utilities” (see [1] for further details). Our application poses two challenges. First, attribute evaluations are not known with certainty – player performance varies from game to game. A common response is to evaluate players based on average performance over the course of a fixed time period. This effectively ignores uncertainty in the evaluations, however. Rather, one should take expectations of *utilities* i.e. compute $E[u_j(Z_{ij})]$ rather than $u_j(E[Z_{ij}])$. We implemented both models to assess the effect of ignoring uncertainty in this context. Second, the rugby analyst explicitly stated that he did not want to impose his own preferences (w_j and u_j) on the problem, and wanted the data to “speak for itself.” This impasse – wanting to apply a preference model but not possessing any preferences – was resolved by an application of an inverse-preference model known as stochastic multicriteria acceptability analysis (SMAA, reviewed in [3]). SMAA solves the “no information” problem by simulating a large number of random weight (and utility, or any other unknown inputs) vectors from appropriately defined probability distributions, recording the proportion and distinguishing features of those simulated values which result in each alternative obtaining a particular rank r (usually the “best” rank, $r=1$). Total ignorance, as in our study, is usually modelled by the uniform distribution.

After implementation, our results consist of two descriptive measures: acceptability indices and central

weight vectors. Acceptability indices give the proportion of all simulation runs that make alternative a_i obtain rank r . We show acceptability indices among centres, as an example, in Figure 1. Although tempting, these should *not* be used to rank players from “best” to “worst.” A player (like Pretorius) with a small but non-zero acceptability may still be a coach’s preferred option, if his preferences are precisely those which support the player. However, it is true that the most “versatile” players are those with high acceptability indices for the best ranks, in the sense that they are supported by a greater proportion of possible preferences. The players with highest acceptability are Ma’a Nonu, Digby Ioane, and Stirling Mortlock. Unfortunately, South Africans did not fare particularly well: the most versatile is Jean de Villiers (who fits the bill of an “all-rounder”, however).

An interesting feature of the results is that many players obtain zero acceptability if mean performances are used, but not if the full distributional outcomes are. If only expected values were considered, these players would not even be considered Pareto optimal. However, their distributional results clearly show that

under *some* circumstances they can be preferred. The use of mean performance values tends to over-exaggerate the relative superiority of certain players (those with better average performance).

The central weight vector is the expected centre of gravity of the set of weight vectors that result in player a_i being preferred, and gives a concise description of the “typical” preferences supporting his selection. Figure 1 shows the central weights of some of the most versatile centres.

Again, some quite different results are obtained with the full distributional and expected value models: ignoring uncertainty has at least some effect. The central weights suggest that Nonu would be preferred by a coach looking for an all-round player but placing slightly more emphasis on running criteria, particularly try creation and line breaks. Some reassurance is provided by former All Black coach Graham Henry's description of Nonu as “probably the best line-breaker in New Zealand”. Ioane is also fairly versatile, but would suit a coach placing even more focus on running variables, with a particularly large weight on tackles

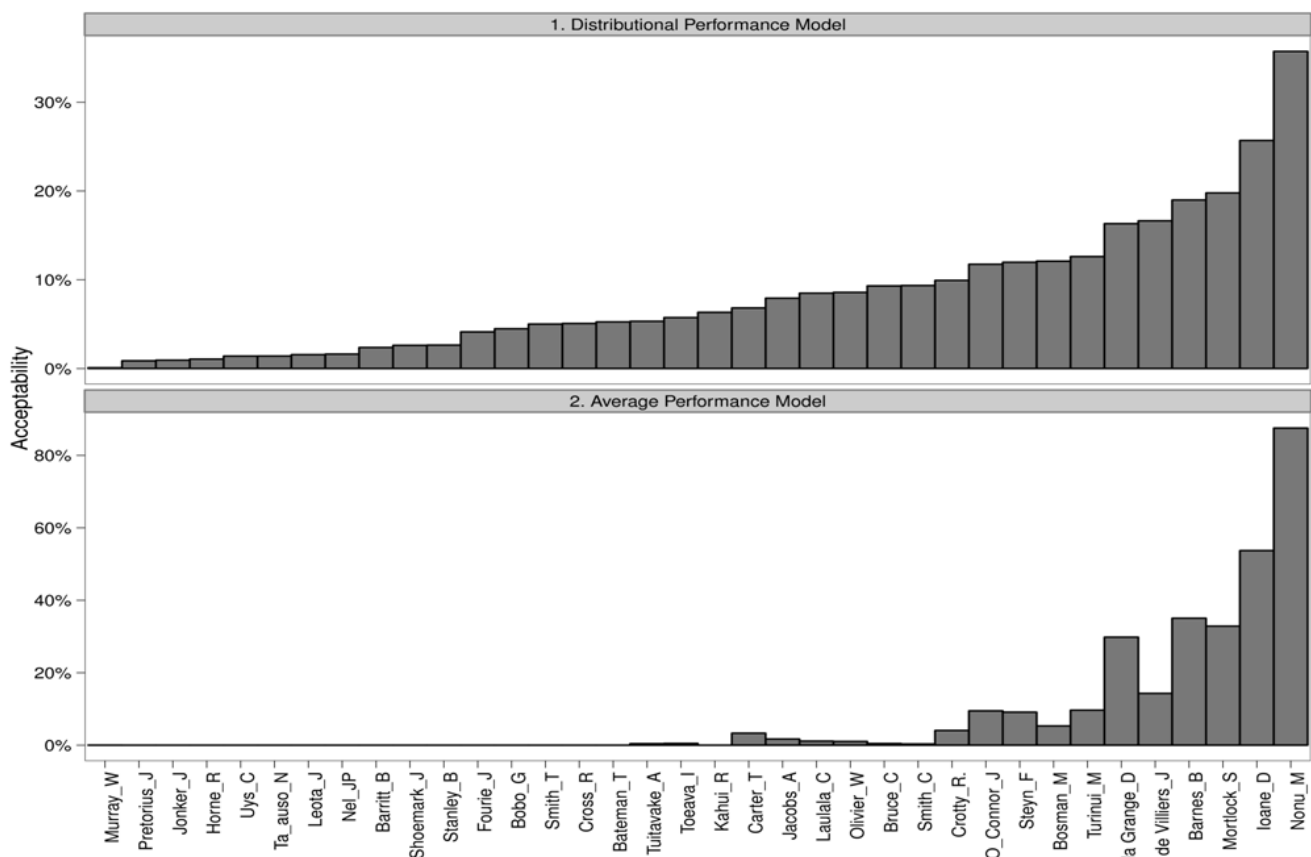


Figure 1: Rank acceptability indices for the centers based on the empirical and average.

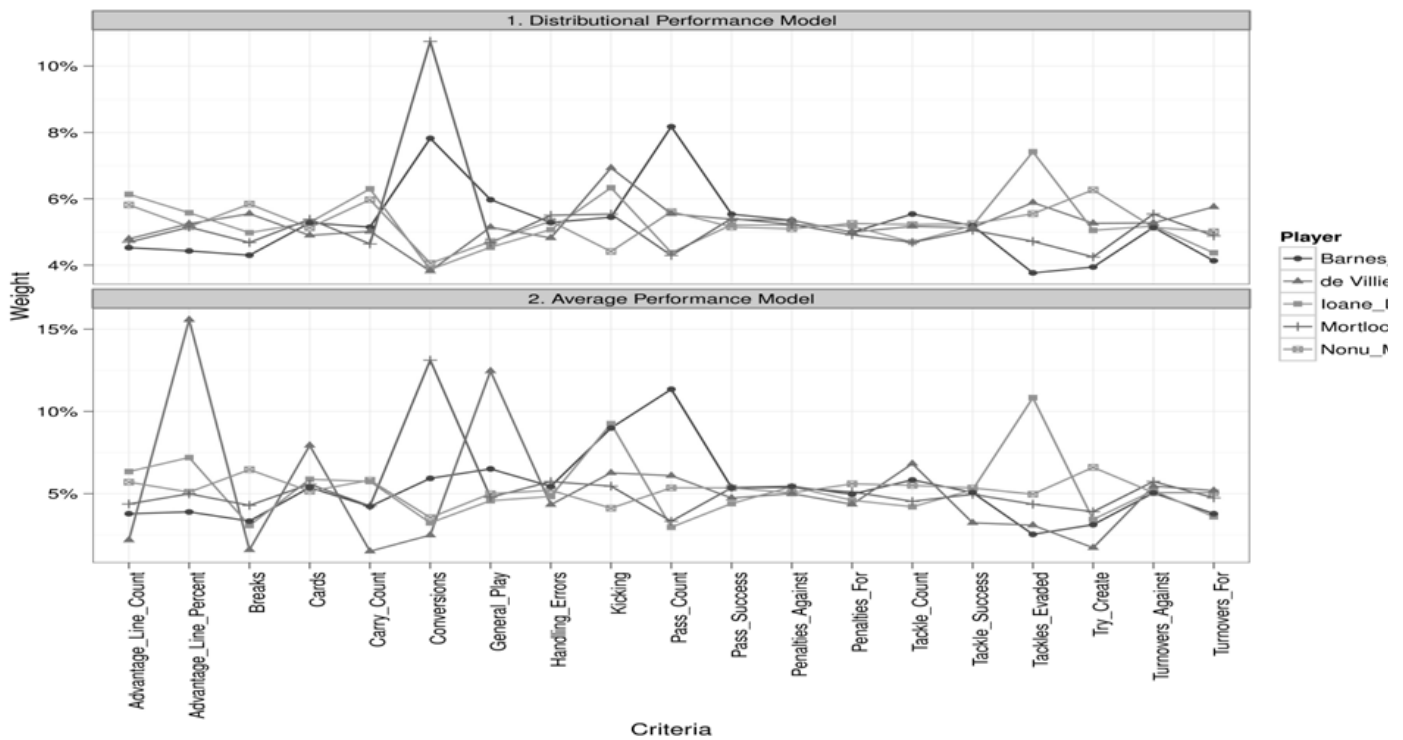


Figure 2: Central weight vectors for some of the centers based on the empirical and average performance models

evaded. The central weights for Barnes exhibit large values for passes, conversions and general play, suggesting that he would be favoured by a coach looking for these attributes. Mortlock would only be preferred under even more extreme preferences, with a substantial weight allocated to conversions. The profile for de Villiers is somewhat unclear. His mean performances suggest strong general play and efficient running, but when the full range of outcomes is considered kicking and turnovers are highlighted, suggesting that in at least some games he performed exceptionally on these criteria.

Decision support can never replace the decision making process of coaches – that is not the intention. Rather the aim is to “support” the coaching process by providing a degree of formality and structure to the problem. Validation in this context is critical but difficult to obtain. In a pilot study conducted on the UCT rugby team using data from the 2011 Varsity Cup campaign, we applied the model to players in the UCT 1st team squad. The coach was first asked to select his preferred team, based on his own instincts and insights. He was then presented with anonymous output from the SMAA model and asked to choose a preferred team. In 10 out of 15 positions the players chosen were the same. The 5 negative results were for the 3 front rowers and 2 locks: this was primarily due to the lack of scrum criteria in the model.

The analyst who commissioned the larger project was walked through the SMAA methodology and results for each position. His conclusion was that the approach showed potential and seemed to reveal some interesting insights on player profiles and performance, although a more thorough interrogation of the results is ongoing and it remains to be seen whether the model will prove useful at a franchise level. In the meantime he has unfortunately left the Stormers for another Super Rugby franchise, so that any benefit would accrue to – the horror, the horror – an Australian team.

References

[1] Belton, Valerie and Stewart, Theodor. *Multiple Criteria Decision Analysis: An Integrated Approach*. Kluwer Academic Publishers, 2001.

[2] James, Nic and Mellalieu, Stephen D and Jones, Nicholas M P. The development of position-specific performance indicators in professional rugby union. *Journal of Sports Sciences*, 23(1):63-72, 2005.

[3] Tervonen, T. and Figueira, J.R. A survey on stochastic multicriteria acceptability analysis methods. *Journal of Multi-Criteria Decision Analysis*, 15(1-2):1-14, 2008.

HARNESSING THE POWER OF DATA TO OPTIMISE BUSINESS RESULTS

Francois Beyleveld, at SAS, explains why sustainability as a concept offers a watershed of opportunity for better business performance through innovation, while also benefiting the planet and employees' own careers.



Francois Beyleveld

More and more South African companies are beginning to realise that 'greening'

their IT infrastructures brings greater business efficiency, return on investment and improved levels of service to their organisations.

In fact, organisational performance as we know it, demands sustainability measures across social, environmental and economic factors, which in turn requires the vital steps of integrating and analysing data to achieve new goals and transform internal organisational cultures. Technology companies in particular are at the forefront of green IT initiatives, because they acknowledge that their reputation as socially responsible entities is critical.

The right choices

By deploying the right technologies, IT can play a significant role in furthering a company's ability to monitor, analyse and implement more sustainable, or green practices, defined as those that meet the requirements of the present day without compromising the ability of future generations to meet their needs. In many cases, making small, incremental changes in IT processes can lead to definitive benefits.

When it comes down to the practicalities of doing business in an increasingly energy-hungry world, most companies are now looking at their supply chain and their ability to measure, monitor and improve their efficiency footprint within their organisations. Those that cannot demonstrate that value, might find themselves out in the cold when the next tender request comes around.

Another aspect that is becoming more important in green IT is employee retention and recruitment. Talented employees have many employment options and are increasingly looking at their employers and their stance

on corporate responsibility and the environment. Clearly, reducing energy use is more about being environmentally responsible. To ensure their long-term viability, organisations must begin now to find and implement solutions that decrease power consumption.

The tools

The good news? Many of the same tools and practices that have enabled these organisations to reduce IT complexity, streamline operations and controls are also highly effective in energy use to help companies become lean, clean and green organisations. These include data de-duplication, high availability and virtualisation, power management and energy efficient data centre design.

The most strategic enterprises will use data, and the intelligence gained from it, to their competitive advantage – driving increased brand value through innovation and improving internal efficiencies and accountability. They will also build loyalty in consumers, employees and other stakeholders – such as in higher education where they track, communicate and educate on sustainability.

Today, companies are able to measure, manage and report on the Triple Bottom Line – environmental, social and economic indicators – and determine business strategies to reduce risk and increase shareholder value.

The results

Harnessing sophisticated software, companies are able to measure key sustainability activities using methodologies and protocols, utilising their existing data in operational systems and databases.

They are also able to report ongoing performance to ensure transparency with key stakeholders and compliance with regulatory agencies. By establishing an integrated, consistent source of quality information, companies can bind initiatives to a common

sustainability framework that allows alignment across all lines of business – from water treatment facilities to the data centre,

Additionally, companies are able to improve performance by identifying metrics that have the greatest impact on goal attainment so that they can make the most informed strategic decisions by using optimisation, forecasting and data mining capabilities to analyse scenarios and run simulations to improve response and successful strategy execution.

Organisations can also manage and forecast the finances and resources needed to achieve the desired outcomes across the enterprise and within each department. Using analytics, they are able to prioritise organisational strategies and align investments in new product innovation, programme management and talent accordingly and establish scorecards and strategy maps driven by the sustainability goals of the organisation.

To end

In closing, going green offers a vital path to innovation and creating enduring value and competitive advantage. Despite the challenges of adopting an environmental mind-set, the direction that companies have to head in is clear, and it is clear that IT has a key role to play. When people start understanding the strategic risk and strategic opportunities of climate change in terms of its impact on brand value, their market and their operations, they'll get engaged in a much broader environmental agenda.

To learn more about how to meet the requirements for real-time decision making, contact SAS on +27 11 713 3400 (Johannesburg and Pretoria) or +27 21 912 2420 (Cape Town) or visit www.sas.com/sa



THE
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MEMBER INTERVIEW: ANGELA RADEMEYER

Contactable at: angela.rademeyer@opsi.co.za



Angela Rademeyer

Angela is in the final year of her PhD in Operations Research at WITS. Her research topic is *Algorithmic approaches to solving multi-period sales force and delivery vehicle master routing problems*. She has been working at OPSI Systems since January 2006 and currently manages the consulting team and is involved in product development.

When and how did you first become involved with OR and in particular ORSSA?

I took an OR course in my honours year while studying towards a degree in statistics and actuarial science. I guess the bug bit when I realised how versatile OR techniques were for solving problems outside of the financial industry. When offered an opportunity to work at OPSI, I decided it was worth the risk to step out of my comfort zone and follow a career in the relatively unknown field of OR. I joined ORSSA in 2009 but only really became actively involved last year.

What aspects of ORSSA do you enjoy most as a member?

I enjoy the fact that ORSSA events bring together people from academia as well as industry and enable members to talk about ways to bridge the gap between research and practical application. ORSSA also connects us to the greater OR community so we know what is happening internationally in the field of OR.

Can you elaborate on the role that OR plays in your day to day job, as well as for the company you work for as a whole?

At OPSI we focus on logistics problems – essentially these are all extensions of the TSP and VRP with many

real-world constraints and features never seen in academic literature. We cannot simply ‘look up’ the best solution techniques for these combinatorial optimisation problems which our clients ask us to help them solve. Often, we need to try a few different OR techniques before coming up with a satisfactory solution. In order to do this we often go and observe what happens in warehouses, depots and vehicle dispatching areas. Typically we then utilise OPSI’s suite of routing optimisation software packages and/or custom written code to model the client’s operations. We also make use of OR and statistical techniques to clean and validate the input data for these models and to analyse the results.

It is widely believed that OR is not sufficiently recognised nor utilised for the strategic tool that it is in South Africa, both in industry and government, be it at municipal, provincial or national level. What, in your opinion, can ORSSA and its members do to make people better aware of the social, economic and environmental benefits that OR has to offer?

I think it would help if ORSSA attended career days at high schools and collaborated with university career guidance units so that school pupils and students are aware of OR as a profession. As far as I know, some universities do work on projects with industry partners but perhaps they need to offer their services more proactively to government as well. ORSSA could compile a list of companies and organisations their members are currently employed in to help guide OR students into the different opportunities for practise. People in many companies throughout SA are utilizing OR techniques to make important decisions, but since they are isolated they are often re-inventing the techniques for themselves, or duplicating one another’s efforts. Practitioners should try to create OR teams within their workplaces to leverage the benefits of their knowledge and experience. After all, the best advertisements for OR are the results we can achieve!

Have you been involved in any interesting OR related projects of late, and if so, could you provide us with some brief details?

We have been working on an algorithm for a new software tool which will plan efficient routes for sales reps, service technicians, home health care nurses etc. These multi-day master routes are created by assigning

customers/patients to a rep/nurse as well as deciding what days the visits should take place. The customers/patients are usually seen with different frequencies (twice a week, weekly, fortnightly, monthly, etc.) so visit patterns must apply to ensure the spacing of the visits is correct for the period you are planning. In addition, the optimal rep/nurse home locations (the start and end points of the routes) may need to be suggested as output. Another layer of complexity is added when reps/nurses are permitted to sleep out when travelling long distances. We are using a memetic algorithm to solve this problem along with different clustering algorithms and techniques from computational geometry, such as Voronoi diagrams.

What are some of the fonder memories you have thus far in your OR career?

I really enjoy brain-storming ideas with my colleagues and combining suggestions to solve problems that leave us feeling we've just done lots of brain gym! Each year the demands of OR from industry are increasing so we never seem to run out of interesting problems to solve. Since most of my work involves optimising distribution operations, I often need to consult with clients' management teams about all the areas of their business 'upstream' from distribution. You have the opportunity to then not only learn about a wide variety of different industries but also realise the impact your proposed changes may have. The indirect benefits of these changes, which positively affect peoples' working environments, are often greater than the cost savings and this is very satisfying.

Do you have any advice for aspiring OR practitioners here in South Africa?

Try and take a diverse range of courses during your studies because the more tools you have in your toolbox the better – you never know what type of mathematical technique you may need to apply one day. Having some programming knowledge is also very beneficial. If you are going to pursue post-graduate studies I would recommend getting some work experience beforehand. And when you do have a job, be prepared for a lot of questions when people want to know what your profession is all about!

Finally, I would like to know whether and how often OPSI Systems recruit people with an OR background?

OPSI has three main divisions – Development, Implementation and Consulting. We have people with an OR background in all departments. We are continually growing and recruit whenever the need arises or we get a CV we cannot turn down!



THE UNIVERSITY *of* EDINBURGH

OR54 Annual Conference

4 – 6 September 2012, Edinburgh, UK

www.theorsociety.com/Pages/Conferences/OR54/O

R54.aspx

OR54 is the annual conference of The OR Society, the world's oldest-established learned society catering to the Operational Research profession, and one of the largest in the world, with 3000 members in 53 countries.

The University of Edinburgh is the very attractive location for this conference which will be based in the John McIntyre Conference Centre – a state of the art conference facility. Edinburgh is the capital city of Scotland and the home of its Parliament.

The list of parallel streams once again offers a wide variety of interest on many topics with more to follow, including credit risk management, criminal justice; green logistics; information systems and knowledge management; logistics and supply chain; forecasting; data mining and computationally intensive methods; OR and strategy; project management; making an impact (practitioner's day); routing applications and transportation; scheduling; simulation; timetabling and related logistical problems; optimisation and revenue management.



Saïd Business School

UNIVERSITY OF OXFORD

International Symposium on Combinatorial Optimisation
17-19 September 2012, Oxford, UK
www.sbs.oxford.edu/co2012

CO 2012 is an international Symposium on Combinatorial Optimisation. It is the next in a series of biennial conferences, and is hosted by the University of Oxford. The program topics will be on any subject related to theory and applications of combinatorial optimisation, which includes but is not limited to: computational complexity, constraint satisfaction, crew scheduling, cutting and packing, data mining, exact and approximation algorithms, frequency assignment, graphs, heuristic methods, integer programming, location, meta-heuristics, network design, polyhedral theory, production and logistics scheduling, timetabling, and vehicle routing and scheduling.



OR 2012
Operations Research 2012, International Annual Conference of the German OR Society,
September 4 – 7, 2012, Hannover, Germany
www.or2012.de

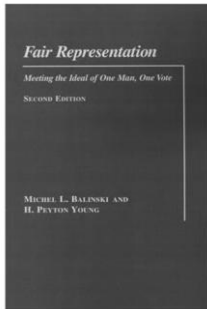
Special attention will be given to the three topics Energy, Markets and Mobility:

- Climate-neutral production, transportation, storage and use of energy lead to numerous new questions for OR.
- Understanding and managing financial markets as well as markets for goods and services challenge OR experts – consider the recent global economic crisis or world wide food shortages.
- More and more people demand mobility over both short and long distances. New mobility concepts that are both efficient and sustainable need to be understood and managed.

The OR conference in Hannover will address these topics from an OR perspective, treating them not only in isolation, but also with respect to their numerous and exciting interconnections, such as new energy for new mobility concepts and new market mechanisms for sustainable energy production, to name but a few. We will draw on the vast local expertise to organise an exciting and truly interdisciplinary conference in Hannover. As in former years, the conference will also provide ample opportunities to present OR-related research results in 18 different streams, representing the many problem-orientated and methodological aspects of Operations Research as a rich and vivid academic field.

Fair Representation – Meeting the Ideal of One Man, One Vote.

by Hans Iltmann (hittmann01@gmail.com)



Reviewing a book that was published more than 10 years ago seems very strange. However, the topic is of interest since it concerns an issue that is both political and mathematical. The short article, titled “Fair Representation of Groups in

Institutions” in the December 2011 IFORS newsletter by Heiner Müller-Merbach prompted this review. In addition the reviewer has been involved in election forecasts for the past 13 years in a country where a proportional representation system was introduced at the dawn of the new democracy in 1994. The book *Fair Representation* is possibly one of the better and authoritative references on this topic.

The basic problem addressed is how to fairly divide the seats in the legislature of a country according to either the size of the population in a state, or province, or the number of votes received by a specific political party. What seems to be a very simple and straight forward issue turns out to be more complicated. The underlying problem is the fact that a perfectly fair division is not achievable because of the indivisibility of seats. This invariably leads to over-representation in some states and under-representation in others, thus making the ideal of one man one vote difficult to achieve.

The authors outline the aim of the book as being: “to establish a solid logical foundation for choosing among the available methods of apportioning power in representative systems. It is an example of mathematical reasoning applied to a problem of public policy. The style of analysis is similar to the axiomatic approach used in mathematics, where the objective is to discover the logical consequences of certain general principles. The validity of the approach depends on identifying the right principles as revealed through history, political debate, and common sense.”

The first half of the book covers the historical developments that led to various different methods used for apportionment since the establishment of the United States in 1776. It is a very detailed discussion the history of how politicians developed different methods to suite changing circumstances. The USA example is rich with variations in this regard although some readers may find the fact that this country is used problematic. The focus is entirely on electing members to the House of Representatives, one of the two chambers of the Congress of the USA. The other chamber is the Senate and there the US constitution stipulates very clearly that every State should be represented by two senators. For the House of Representative the constitution states: “*The Number of Representatives shall not exceed one for every thirty Thousand, but each State shall have at least one Representative*”. As the population increased over time it was obviously necessary to increase this number. In 1911 it was decided, however, to limit the number of representatives in the House to 435. The constitution also stipulated that a census will be held every ten years and the census numbers will then be used for the apportionment.

From the historical overview it is clear that ideally each state should have the same number of representatives per million people, but this is impossible to achieve exactly. Suppose, as is stipulated by the US constitution, that one sets a quota of one representative per 30,000 voters and finds that a particular state should then get 1.6 representatives, should the state get 1 or 2? Another real example given in Chapter 3 illustrates some of the difficulties of apportionment. Delaware and Massachusetts were two early states with populations of 55 540 and 475 327 respectively in 1791. For this example the quota is the same as above namely 30 000 voters (the divisor). Through the resultant apportionment, using the Jefferson method, Delaware got a quotient of 7.895 and Massachusetts 15.844, and

ultimately each got 7 and 15 representatives respectively since fractions are discarded. The question then is: Is this fair? Delaware gets one seat for 55 540 persons and Massachusetts one seat for 31 688 persons. This implies that every resident in Delaware has a 43% smaller share of representation in the House than a resident of Massachusetts. Surely this is not fair! Ignoring fractions tends to favour large states. Throughout the first part of the book examples like these are used to illustrate the difficulties that arose with apportionment over time.

This all led, initially, to methods proposed by politicians such as Jefferson, Hamilton, Adams, Webster and Dean, plus a few others. In most cases the new methods came about because of a shift of one or two seats – small changes, but for politicians this was serious because it affected political power. Subsequently Hill and Huntington became involved, both trained mathematicians. In the end the question remains “so what method should be used?” There is no conclusive outcome. Balinski and Young describe in detail all the methods that have been advanced, and adopted, over the years. It is a fascinating historical account of endeavouring to reach for the ideal of one man, one vote where no man should have a greater voice than another! In the end the conclusion is that the current apportionment formula cheats – larger states are favoured above the smaller ones contrary to the intentions of the founding fathers and compromising the notion of “one man, one vote” rulings.

In the second part of the book there are two appendices. Appendix A is a comprehensive theoretical exposition and mathematical representation of the logic and arguments behind this problem area. The mathematics is rather challenging although the reader only requires some elementary algebra and probability theory as background. In this appendix the text and methods are translated into, and explained, in a mathematical form. Appendix B gives the results of the representative populations and apportionments for the twenty-two censuses from 1791 to 2000. In all cases the apportionment using six different methods are given illustrating how these differ.

No mention is made in the book about other methods, or approaches, used elsewhere in the world such as, for example, the Single Transferable Vote method. This

does not, however, detract from the value and insight obtained from *Fair Representation*.

The authors are able to show how something which literally requires simple arithmetic developed over time, capturing not only history and politics, but at the same time putting it across in mathematical terms. Finally one has to agree with the authors, quoting a representative in 1882 who declared (with pardonable exaggeration): “*Since the world began there has been but one way of proportioning numbers, namely, by using a common divisor, by running the “remainders” into decimals, by taking fractions above .5 and dropping those below .5; nor can there be any other method. The process is purely arithmetical... If a hundred men were being torn limb from limb, or a thousand babes were being crushed, this process would have no more feeling in the matter than would an iceberg; because the science of mathematics has no more bowels of mercy than has a cast-iron dog.*”

Book info: *Fair Representation – Meeting the Ideal of One Man, One Vote* by M. L. Balinski and H. Peyton Young, 2001, Brookings Institute Press, Washington, D.C., USA, 195 pp. ISBN 0-8157-0090-3, 22.95 US dollars.

DISCLAIMER

The views expressed in this newsletter are those of the contributors and not necessarily of the Operations Research Society of South Africa. The Society takes no responsibility for the accuracy of details concerning conferences, advertisements, etc., appearing in this newsletter. Members should verify these aspects themselves if they wish to respond to them.

Brain Teaser Solution

The solution is 2. There is no actual pattern or trend. The number to the right of the equals sign is a sum of the number of closed circles made by the individual digits on the left, e.g. $8 = 2$ because it has 2 closed circles.



2012 41st ORSSA Annual Conference

16-19 September 2012

An advance warm welcome to the 41st Annual Conference of the *Operations Research Society of South Africa* (ORSSA)! The Conference will be hosted by the Pretoria Chapter of ORSSA, supported by the Johannesburg Chapter, and will be held at the Aloe Ridge Resort, north west of Johannesburg, from September 16th to 19th, 2012.

The conference will open with a welcome reception on Sunday evening September 16th and will close at lunchtime on Wednesday September 19th. Participation over the full spectrum of Operations Research is encouraged, including papers of a more fundamental nature, those on the application of Operations Research techniques in business and industry, about topical issues in Operations Research, and about the

Important Dates

14 March	Early bird registration & abstract/paper submission opens
30 June	Abstract submission closes for reviewed papers
30 June	Early bird registration closes
11 July	Abstract submission closes for oral presentation of all papers
29 July	Notification of abstract acceptance for non-reviewed papers
22 August	Notification of acceptance of reviewed papers for proceedings
22 August	Notification of acceptance for non-reviewed papers
22 August	Notification of acceptance of reviewed papers for proceedings

philosophy, teaching and marketing of Operations Research.

Delegates are responsible for their own travel and accommodation arrangements. The Aloe Ridge Hotel is recommended, as the Society has arranged *very* competitive rates for delegates. Travel directions to and reservation contact details of the Aloe Ridge Resort may be found by visiting the ORSSA website at the address below.

Conference delegates have the option either to present non-peer reviewed papers at the conference (as we have become accustomed to in the past, and for which only an abstract submission is required), or to submit full papers for peer-review with the intention of having their papers published in conference proceedings, if accepted for publication.

Registration Fees

Delegate Category	Fee
Student Early Member	R 1450
Non-student Early Member	R 2450
Student Non-early member	R 1550
Non-student Non-early Member	R 2550
Student Early Non-Member	R 1650
Non-student Early Non-member	R 2650
Student Non-early Non-member	R 1750
Non-student Non-early Non-member	R 2750

Please visit the conference website for more information:

www.orssa.org.za

(click on 2012 Conference)



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