



AT THE FOREFRONT OF ANALYTICS IN AFRICA



ORSSA Newsletter March 2014

www.orssa.org.za



The Centre for Business Mathematics and Informatics[®]
presents a

first of its kind in South Africa

Developing high performing **BUSINESS ANALYTICS** professionals

MSc in BMI with specialization in Business Analytics – is the ultimate post graduate qualification for analytically talented persons with a background in Statistics, Mathematics, Applied Mathematics, Engineering and Operational Research. The programme is currently **full time** and not available on a part time basis. The programme will start the last week of January 2015 and runs until the end of November 2015.

What is Business Analytics?

Businesses worldwide – whether they are public or private, large or small – capture data on a daily basis. This data deluge has created a serious need in the labour market for skilled

Business Analytics/Data Scientists professionals who can use sophisticated analytical techniques and computer technology to analyse business problems, optimise data-driven decision-making and provide business solutions in a dynamically changing world. See the following links (<http://analytics.ncsu.edu/>) or Google: Data Science/ Big data.

Requirements:

Bachelor Honours Degree in Mathematical Science or a cognate Bachelor's Degree at Level 8 with intermediate programming skills.

Bursaries:

Top students stand a chance of obtaining a bursary that will cover their tuition fees.



Contact person – information about the programme
Prof Machiel Kruger
Tel: 018 2992567
E-mail. Machiel.Kruger@nwu.ac.za

Application:

Closing date: 29 August 2014.

Successful applicants will be notified before the end of November 2014

In order to apply, please contact:
Me Lise Hendriks
E-mail. Lise.Hendriks@nwu.ac.za



Centre for BMI
Senteramo ya DII
Sentrum vir BWI



NORTH-WEST UNIVERSITY[®]
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
POTCHEFSTROOM CAMPUS

FROM THE EDITOR

By MARK EINHORN (einhorn@sun.ac.za)
 ORSSA NEWSLETTER EDITOR



Mark Einhorn

Greetings to all you ORSSA members out there and welcome to the first edition of the Newsletter for 2014. I trust that you all had a peaceful and enjoyable festive season and that 2014 has been kind to you thus far.

I would like to take this opportunity to wish our new president, Hennie Kruger and his Executive Committee all the best for the coming year, and

I have no doubt that they will take all steps necessary to continue the advancement, and increase the awareness of Operations Research in South Africa.

Right, now that the pleasantries are taken care of, let's delve into the contents of this Newsletter, shall we? I would like to first draw your attention to the very important notice on page 16 regarding the change in banking details of the society. Please do read it.

We get a double-dose of our new president in this issue in the form of his first presidential column as well as a very interesting interview with Hennie in which I was afforded the opportunity to pick his brain on various topics regarding the society and his role as president.

This issue also sees the first installment of a series of articles on the state of OR at various South African universities, the first being Stellenbosch University (no bias I promise!).

The feature article of the issue is written by a previous contributor, Collin Philips of OPSI Systems, and discusses optimisation of the cash in transit process, definitely worth a read and another excellent example of the application of OR techniques in industry.

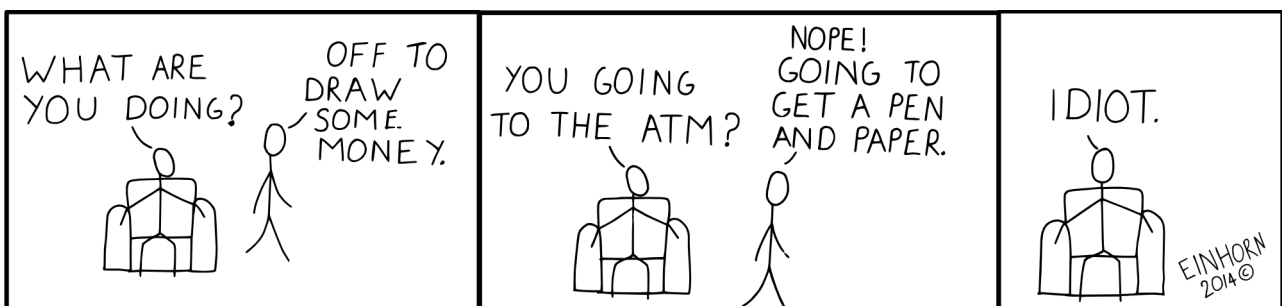
That's all from me for now, until June, cheers all and enjoy the read!

Features Page

FROM THE EDITOR	1
FROM THE PRESIDENT'S DESK	2
THE 2014 ORSSA EXECUTIVE COMMITTEE	3
OPERATIONS RESEARCH AT SOUTH AFRICAN UNIVERSITIES PART I: STELLENBOSCH UNIVERSITY	4
CLOUD COLLABORATION FOR THE SUPPLY CHAIN OF TOMORROW — EVENT SYNOPSIS	5
CASH IN TRANSIT OPTIMISATION	6
GETTING TO KNOW OUR PRESIDENT: AN INTERVIEW WITH HENNIE KRUGER	13
BOOK REVIEW: THINKING FAST AND SLOW	15

QUERIES & CONTRIBUTIONS

Any queries or contributions to the Newsletter are most welcome, especially article submissions. For any queries or contributions, please contact the Newsletter editor at einhorn@sun.ac.za.



FROM THE PRESIDENT'S DESK

By HENNIE KRUGER

(Hennie.Kruger@nwu.ac.za)

ORSSA PRESIDENT



Hennie Kruger

While I'm writing this, we are already busy with all the activities of 2014's first term. I trust that everybody has enjoyed a well-earned respite and that some of your New Year's resolutions have already been achieved (or forgotten!). One way or the other, I wish you all a prosperous 2014. I want to start my first contribution by thanking you for the immense privilege to serve as president of ORSSA. Be assured that I will try my best for the society.

A word of welcome to all the new members of ORSSA, as well as the two new members on the Executive Committee, namely Tiny du Toit (new treasurer) and Angela Rademeyer (additional member). Unfortunately, Jonas Stray had to resign from the Executive Committee due to work pressure. On behalf of the society I want to thank Jonas for the outstanding work he has done as treasurer during 2013. I also want to thank Jan van Vuuren on behalf of ORSSA. Jan's term as president expired at the end of 2013. During his term, he worked tirelessly and with absolute professionalism for the society. Many of the recent new initiatives, like the new award categories, student medals, marketing portfolio and so forth can be ascribed to Jan. Thank you, Jan – I would have liked to wish you a pleasant time of rest, but since you are going to serve as vice-president in 2014, I (and ORSSA) will still depend largely on your knowledge, experience and insights and thus the period of rest will have to wait a little bit longer. Jan has moved from the Department of Logistics to the Department of Industrial Engineering at Stellenbosch University and we wish him all the best in his new work environment.

Thank you to all the members of the Executive Committee for sacrificing once again some of your precious time in 2014 to develop the society even more and manage it in a professional way. The members' names of the entire Executive Committee of 2014, with their respective portfolios, can be found on page three.

I believe that exciting times and opportunities await us in 2014. To make use of them, though, we will have to be on the lookout to see and grab these opportunities. In order to illustrate this, I want to quote a short passage from *Smart thinking for crazy times* by John Lloyd that can surely be applied to ORSSA. Even if some of you have already read or heard it before, it is worth reflecting upon again.

Until 1954, runners faced the impenetrable barrier of the four-minute mile. Running the mile in under four minutes was something beyond human comprehension. As it was beyond human comprehension, so it was beyond human achievement. Athletes had dreamt for years about the goal of running the mile in less than four minutes, but it seemed beyond the reach of any runner.

In May 1954, Roger Bannister, who had failed many times before, shattered this barrier. He had done the impossible and run the mile in three minutes fifty-nine point four seconds. Two months later, Bannister's "miracle mile" was broken by John Landy who improved on the record time by one point four seconds. Over the next three years the record was broken a further sixteen times.

What happened over those three years? Had there been a sudden growth in the evolution of runners? Improved genetic engineering? No, the running shoes, tracks and equipment were the same. The main change was the mental model of the runners. They had all been held back by the belief or mindset that they couldn't beat the four-minute mile.

When the limit or glass ceiling was smashed, the others saw that they could do something they had all previously thought impossible. This is a great example of how our mindset limits or expands our world.

John Lloyd refers to this expansion of our mind-set as "four-minute mile opportunities". The question is the following: Where in ORSSA are there four-minute mile opportunities that we have not yet seen as "possibilities"? What is keeping us back? Naturally, I do not only speak of huge and impressive breakthroughs, but rather of those things (even the smallest ones) that will take us forward, step by step. The good news is that ORSSA has already seen and made use of four-minute mile opportunities. Some examples are the Africa outreach programme, new student medals, new award categories, peer-reviewed conference proceedings, a new marketing portfolio, closer ties with the industry and the obtaining of sponsorships (there were 15 representatives from the industry at the ORSSA Conference in 2013). I want to encourage each ORSSA member to be on the lookout for the four-minute mile opportunities that occur everywhere – when we make use of the smaller opportunities, they change automatically into greater achievements.

I want to wind up by saying that I am looking forward to 2014 and to work closely with the Executive Committee, as well as each individual member, in pursuing our ORSSA ideals. I also want to invite each member sincerely to contact me, or any other member of the Executive Committee, with any comment, suggestion, idea, or four-minute mile opportunity.

With best wishes / Alles van die beste
Hennie Kruger

THE 2014 ORSSA EXECUTIVE COMMITTEE



President:
Hennie Kruger



Vice-President:
Jan van Vuuren



Secretary:
Tanya Visser



Treasurer:
Tiny du Toit



Database Manager:
Ian Durbach



**Marketing
Manager:**
Dave Evans



ORiON Editor-in-Chief:
Stephan Visagie



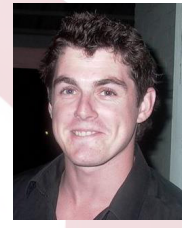
**ORiON Journal
Manager:**
Martin Kidd



**Newsletter
Editor:**
Mark Einhorn



**Newsletter Business
Manager:**
Daniel Lötter



Webmaster:
Niel Mathee

Additional Elected Members



Margarete Bester



Elias Munapo



Elias Willemse



Angela Rademeyer.

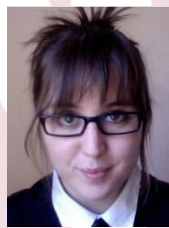
Chapter Chairs



Johannesburg:
Louis Dannhauser



Pretoria:
Winnie Pelser



Vaal Triangle:
Lieschen Venter

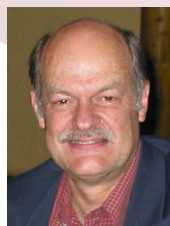


Western Cape:
Daniel Lötter



Kwazulu-Natal:
Aderemi Adewumi

Co-opted External Liaison Representatives



IFORS Representative:
Hans Ittmann



EURO Representative:
Theo Stewart

OPERATIONS RESEARCH AT SOUTH AFRICAN UNIVERSITIES PART I: STELLENBOSCH UNIVERSITY

by Mark Einhorn (einhorn@sun.ac.za), Stellenbosch University

The first appearance of OR in any curriculum at Stellenbosch University occurred in 1962 in the form of a series of lectures on OR, presented by Gerhard Geldenhuys (a lecturer in Applied Mathematics at the time) during the final semester of the third year syllabus of Applied Mathematics for BSc students.

Today, there are two centres of Operations Research at Stellenbosch University: the one is located within the Department of Industrial Engineering and is headed by Professor Jan van Vuuren, and the other is located within the Department of Logistics which is part of the Economic and Management Sciences faculty and is headed by Professor Stephan Visagie

In the Department of Industrial Engineering, Operations Research comprises part of the four-year Industrial Engineering degree and is presented during the third and fourth years of study. During the third year of study an Operations Research module on deterministic models is offered during the second semester, while in the fourth year of study, a module on stochastic models is presented during the first semester.

For post-graduate students pursuing a Masters or PhD degree in Operations Research within the Department of Industrial Engineering, there is a state-of-the-art research lab available to the students in which each student receives a dedicated work station with all necessary computing facilities at their disposal to aid and facilitate their research.

There is a Unit for Systems Modelling and Analysis (USMA) within the Department of Industrial Engineering. USMA is a research group comprising post-graduate students within the Industrial Engineering Department at Stellenbosch University. The group's focus is the research and application of advanced analytical methods. Research ideas and outputs are shared amongst one another providing a platform for continual development.

Methods and techniques applied within USMA include a combination of metaheuristics, computer simulation, mixed-integer linear programming and models from the theories of Markov chains, cooperative games and queuing systems.

Much of the research within the unit deals with the field of discrete-event simulation (DES) in combination with

metaheuristics as an optimisation tool. This applies in particular to dynamic, complex stochastic processes where the solution space is discrete and the number of possible solutions is too large for a formal experimental design. There might also exist multiple, conflicting objectives. Enter multi-objective optimisation, the rich field of research that the group spends much effort upon. Metaheuristics, such as the genetic algorithm (GA), population-based incremental learning algorithm (PBIL) as well as the Harmonic Search algorithm (HS), are used in simulation optimisation. The cross-entropy method, tabu search and simulated annealing are also used as optimisers. One aspect of the research is to find more efficient and faster algorithms – by modifying them or developing new ones – to mitigate the computational burden imposed by simulation models of real-world systems while ensuring statistical confidence. Industrial problems provide engineering applications and validation test benches for optimisation models.



View of the main campus at Stellenbosch University

Moving across to the Department of Logistics, OR is presented on an undergraduate level during the second and third years of study and is offered as a major subject within the BComm Mathematical Sciences and BSc Mathematical Sciences programmes. During the second year of study, network optimisation is offered during the first semester while linear programming is taught during the second semester. For the third year of study, combinatorial optimisation and multi-criteria decision analysis are offered during the first semester, while during the second semester nonlinear optimisation and stochastic methods of Operations Research are taught.

As with the Department of Industrial Engineering, there too is a state-of-the-art research lab for post-graduate Operations Research students within the Department of Logistics.

CLOUD COLLABORATION FOR THE SUPPLY CHAIN OF TOMORROW

— EVENT SYNOPSIS

by Heidi Barends (heidi.barends@gmail.com) and
Candice Hodgson (candz92@gmail.com), University of Pretoria

On the 20th of February SAIE Operations Research SIG, the Pretoria chapter of the Operations Research Society of South Africa and Resolve collaborated in hosting a networking and information event around the topic of Cloud collaboration for the supply chain of tomorrow.

The evening was kick-started by Carien Botha, the President of SAIE, who shared her vision for SAIE with the audience of 25. The audience consisted of professionals from a variety of fields including Industrial Engineers, Business Intelligence, Procurement, Electrical Engineering and Applied Mathematics. The purpose of events like these, as explained by Mrs Botha, is to bring people, from different fields, together to share their experiences, knowledge and expertise for special interest groups.

The ball was kept rolling by Alwyn Moolman who presented on Cloud Collaboration for the Supply Chain of Tomorrow. In explaining this new framework he elaborated on the traditional supply chain and the problems that are faced within this framework. The paradigm of creating cloud collaboration would be to create a supply chain network of organisations, allowing free flowing information between partners, moving away from segmented, isolated organisations who plan independently.



Guests of the event were afforded valuable networking opportunities

An illustration of the numerous advantageous followed. In implementing cloud collaboration it is possible to create a single version of the truth – that allows for improved decision making for all involved parties. This can, in turn, decrease the bullwhip effect and, if implemented correctly, could lead to continuous forecasting based on point of sale data.

A more technical perspective was then presented by Andrew Britz. Without the tremendous leaps technology has made in recent years, cloud collaboration would not be possible. Mr Britz first explained the many problems that are faced by professionals in the computing industry when attempting to solve problems in the traditional supply chain. A modern computing approach is needed to solve these problems; cloud computing being the solution. In essence cloud collaboration uses the existing ERP systems of the partnering organisations to allow for information sharing in the network, assisting in joint problem solving. A permissibility layer is included so that organisations can control the data that are visible to different partners. Question-and-answer sessions were held after both presentations. These opened the floor for idea and knowledge sharing between different professionals.



Guests eagerly awaiting a presentation.

SAIIE OR and ORSSA would like to thank *Resolve* for their sponsorship in making this event possible.

CASH IN TRANSPORT OPTIMISATION

by Colin Phillips, OPSI Systems (colin.phillips@opsi.co.za)

Have you ever considered how much work goes in to making sure that you can draw cash from the nearest ATM? There are many factors to consider. Decisions need to be made at every level: whether an ATM should be placed in a particular spot, how many ATMs there should be in a cluster (such as a banking mall), on what days the ATMs should be reloaded, how much cash to load into the ATM during each visit, and even how to distribute the work across a fleet of Cash In Transit vehicles.

For our study we looked at one of the major South African banks, and considered all their existing ATMs across the entire country. We excluded the ATMs at the branches, as well as the ATMs which were loaded directly by those branches, as they were handled by a different process, that did not use Cash In Transit vehicles. Our task was to define the best rules to determine what should happen on each day – which vehicle should load what amount into which ATM. Our results would be used to create a weekly base plan, which would then be modified on an *ad hoc* basis to account for things like big rugby games, or long weekends, which change the pattern of how much is drawn from various ATMs.

straints and soft “nice to have” constraints. Some of these we managed to build into the model, but for others, which were harder to express formally, we simply verified that the proposed solution did not break the constraint, and made small manual adjustments to our solution if it did. Here are a few of the more interesting constraints.

The ATMs each have a maximum cash limit (mostly for insurance reasons), which means that for ATMs which pay out large amounts of cash, we couldn’t simply load the ATM once a week with all the cash we expected would be paid out over that week – we needed to stagger the loading amounts across the week. Actually, even if the insurance limit was not an issue, we would not prefer this solution, except in extreme cases. If we load an ATM on Monday with a week’s worth of cash, it means that we expect some cash will simply sit in the ATM from Monday to Sunday, not doing anything. To a bank, money just sitting in one place and not earning any interest represents a loss of potential income. We’d like to avoid that. So really we need to find a balance between the cost of visiting the ATM more often, which incurs fuel and staff costs, and the cost of the lost income which comes from loading the ATM early (which we called the “balance-holding cost”), subject to



An armoured cash in transit vehicle carrying both cash and armed guards.

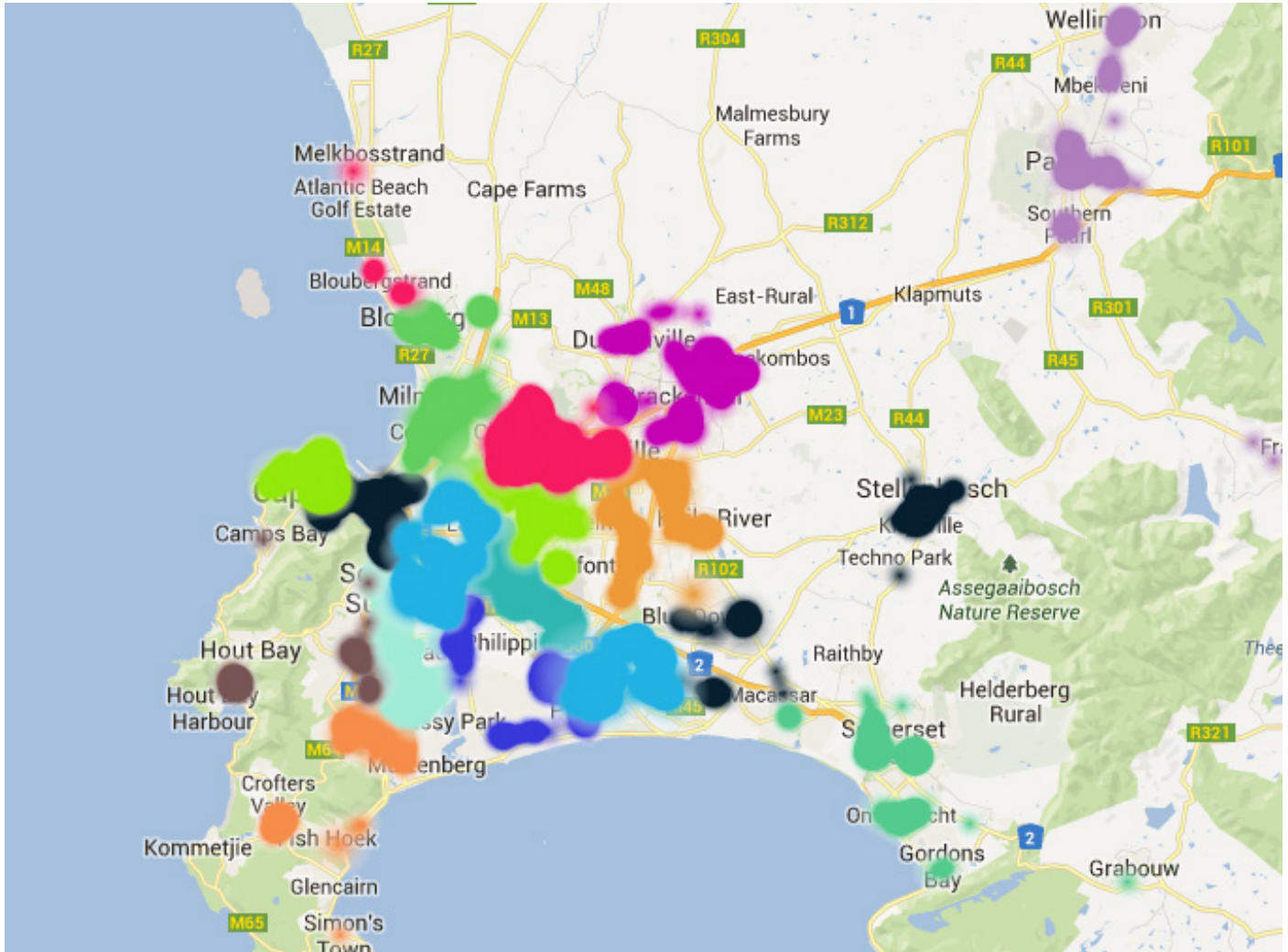
There are a number of constraints we needed to take into account. The constraints make the solution search space smaller and easier to explore, but some also make the modelling much more complex. There were lots of hard con-

straints and soft “nice to have” constraints. Some of these we managed to build into the model, but for others, which were harder to express formally, we simply verified that the proposed solution did not break the constraint, and made small manual adjustments to our solution if it did. Here are a few of the more interesting constraints.

The bank loses potential bank fees (and damages their rep-

utation) every time a customer tries to draw cash and the machine is empty. Therefore, we have an extra constraint – the expected cash balance in any one ATM must always be greater than 0 (actually, greater than some safety stock limit, which is different per ATM, but we can ignore this without loss of generality). However, to make sure we're not breaking this constraint, we need to know for each day

ally ignore many of these factors. We used the bank's own confidence intervals of the payouts per ATM type per day to get our estimate of the cash payout per ATM type per day. We could then work out, for each ATM type, for any proposed set of visit days (we call such a set of visit days, such as Monday-Wednesday-Friday, a "Visit Profile"), how much cash should be loaded into the ATM on each



A heat map of the ATM payout amounts, coloured according to the vehicle assigned to the ATM.

of the week how much cash is expected to be dispensed that day. It turns out that there are some very interesting patterns in the cash dispensed per day, which depend on various factors. Temporal factors, such as the time of year, the number of days until payday, or the proximity to a public holiday, play a large role. Geographic factors, such as the type of area (residential, industrial, commercial, etc.), the average wealth of the area, and the proximity to sports grounds or tourist attractions are also major influences. These effects obviously interact in fairly rational ways. And, of course, what operations research project would be complete without a little bit of uncertainty as well?

Because we were developing a model for the "standard" week, and relying on the bank to make the small *ad hoc* adjustments to the actual amounts loaded, we could actu-

ally ignore many of these factors. We used the bank's own confidence intervals of the payouts per ATM type per day to get our estimate of the cash payout per ATM type per day. We could then work out, for each ATM type, for any proposed set of visit days (we call such a set of visit days, such as Monday-Wednesday-Friday, a "Visit Profile"), how much cash should be loaded into the ATM on each

proposed visit day so as to meet all the constraints while incurring the smallest possible balance-holding cost. The bank needs to trust their Cash In Transit vehicle teams – there is only so much that surveillance can do. However, when a dispute arises, such as when the ATM has less cash in it than expected, the bank needs to know who to talk to. That's why each ATM is assigned to a single team. That team, and that team only, is allowed into the back workings of that ATM. If we allowed more than one team to visit a particular ATM, then each team could blame the other when something went wrong. This is an example of a constraint which considerably narrows the solution search space – it means we need to make the decision of which team visits a particular ATM only once per ATM, rather than once per visit. (Continued on page 11).



**World-class logistics
optimisation in a
single package**

The leading supply chain optimisation and consulting company

Whether it's improving your vehicle fleet's efficiency, arranging your sales teams' service areas, reducing distance travelled or creating visibility into your operations, OPSI Systems provides solutions. Through our software offerings and expert consultants, OPSI can create a solution that's best suited to solving your unique logistic optimisation problems. Contact us to find out how we can help you.

www.opsisystems.com | Tel: 011 880 7951 | email: info@opsi.co.za





43rd ORSSA Annual Conference

14–17 September 2014

An advance warm welcome to the 43rd Annual Conference of the Operations Research Society of South Africa (ORS-SA)! The Conference will be hosted by the Vaal Triangle Chapter of ORSSA, and will be held at Stonehenge in Africa, just outside of Parys, from September 14th to 17th, 2014.

The conference will open with an optional tutorial on Sunday afternoon and a welcome reception on Sunday evening September 14th and will close at lunchtime on Wednesday September 17th. 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 philosophy, teaching and marketing of Operations Research.

The keynote speakers at the conference will be announced in due course.

Following the successful introduction of published conference proceedings in 2011, authors will again have the choice of either (a) only presenting papers orally at the conference, or (b) additionally submitting full papers (which will be pre-

sented orally at the conference) for inclusion in the peer-reviewed conference proceedings. Registration, abstract and full paper submissions will open during the first quarter of 2014.

Delegates are responsible for their own travel and accommodation arrangements. Stonehenge in Africa is recommended, as the Society has arranged competitive rates for delegates.



Stonehenge in Africa

Important Dates

17 March	Early bird registration & abstract/paper submission opens
11 April	Abstract submission closes for reviewed papers
18 April	Notification of acceptance of abstracts of reviewed papers and go-ahead to submit full papers for peer-review
16 May	Submission of full papers for inclusion in the conference proceedings closes
25 July	Early bird registration closes
11 July	Abstract submission closes for oral presentation of all papers
18 July	Notification of abstract acceptance for non-reviewed papers
18 July	Notification of acceptance of reviewed papers for proceedings
15 August	Cut-off for qualification of reduced room rates at the hotel
22 August	Registration closes

Please visit the ORSSA website and click on the link *ORSSA 2014* for more information:

www.orssa.org.za



Fifth International Conference **MATHEMATICS IN FINANCE**

Skukuza, Kruger National Park South Africa
24 - 29 August 2014

Hosted by North-West University in collaboration with the University of Cape Town.

Objective

The main objective of the conference is to bring together academics, practitioners and graduate students who are working in the broad field of financial mathematics, risk analytics and the broader area of business analytics. It is envisaged that participants who are at the forefront of the area will reflect on current open problems and relevant challenges and that they will indicate directions for future research. It is hoped that the interplay between theory and practice as well as issues relating to the dissemination of knowledge and teaching in this field will be discussed.

Target Audience

- Actuaries
- Quants
- Risk and Business Analytics Practitioners
- Academics
- Graduate Students

Confirmed Plenary Speakers Include:

- Bruno Dupire (Bloomberg and New York University, USA)
- Paul Embrechts (ETH Zurich, Switzerland)
- Matheus Grasselli (McMaster University, Canada)
- Andrea Macrina (University College London, UK)
- Mike McAleer (Erasmus University, Rotterdam, Netherlands, and National Tsing Hua University, Taiwan)
- Alex McNeil (Heriot-Watt University, UK)

Deadlines and Registration

The deadline for submitting abstracts is March 31, 2014. Registration will close on April 30, 2014. Note that the number of participants is limited to 150. Registration will be handled on a first-come, first-served basis.

For more information please visit: <http://www.nwu.ac.za/content/mif-2014-landing-page>

Cash doesn't actually take up a lot of space. And although they are usually very fit, strong, and brave, the armed guards on the Cash In Transit team don't completely fill up a Cash In Transit vehicle either. But that doesn't mean that we can fill up a vehicle with as much cash as we like. Rather than a physical space constraint, Cash In Transit vehicles typically have an Insurance constraint – the vehicle insurance will not pay out for hijacked vehicles carrying more than a certain maximum limit, because the more cash in the vehicle, the bigger the risk of hijacking. This is especially true in South Africa. So, to save both cash and human lives, the bank never authorises the vehicles to have more than that limit either.

Some other features of the problem we had to take into account: vehicles which started from one *Distribution Centre* (DC) would have different working hours than vehicles from another DC, and some DCs could only dispatch a few vehicles at a time due to space constraints; different road speeds between points meant that we needed to construct a distance matrix between the pairs of ATMs; and it would take different amounts of time to service a cluster of ATMs depending on the types of ATMs and the number of ATMs in any particular cluster. And, for security reasons, it would be ideal if the vehicle routes were not too predictable, and the stop sequencing between days differed as much as possible.

Once we had understood and formulated the problem, we used a Memetic Algorithm metaheuristic to make decisions on four levels: which DC should be responsible for each ATM; which vehicle at a particular DC should be responsible for actually visiting that ATM; which visit profile should be applied to each ATM; and, for any given vehicle, for any given day, what route the vehicle should follow to be able to visit all of its assigned ATMs requiring visits on that day. Our objective function tried primarily to reduce transportation costs, by reducing total kilometres, total hours, and total overtime hours. However, we also added various measures of the “workload balance” (across the period as a whole, across the period for any one particular vehicle, and between vehicles) to the objective function. The bank also had some ATMs for which there were “preferred days”. Our objective function also included a term to try to maximise the number of ATMs which were seen on their preferred days, if they had any. The objective function included all these terms by means of Simple Additive Weighting.

Memetic algorithms are a powerful metaheuristic tool for such a problem – they allow us to provide suggestions to the computer as to how to build up a solution, based on our own intuitions and observations, while also allowing us to step back and allow the computer to find solutions

which we would not have considered otherwise. However, they are quite resource-hungry, as are all population-based methods. To counteract this, we added in a few simplifying constraints of our own to be able to reduce the solution space. For example, humans know that an optimised solution is not going to require an ATM in Cape Town to be serviced by a vehicle starting from Joburg each morning, but a memetic algorithm needs to try this possibility to be able to eliminate it. We decided to split the country into broad regions wherever there was a “clear” split in the data. We used the bank's current actual allocations of ATMs to DCs to guide us in this, although we had to do some data cleaning and validation.

One of the advantages of using metaheuristic solution methods is that the separation between problem formulation and solution methodology allow us to try out various scenarios without needing to reformulate the model into a new format each time. We were able to explore a number of different scenarios, such as outsourcing the servicing of those ATMs that were “out of the way” or inconvenient to get to for whatever reason, or changing the insurance maximum on the vehicles. We also tried allowing the model to reduce the visit frequency if this would appreciably reduce the costs, and changing the working hours of the vehicles. In the end, we were able to provide the bank with a selection of options for each DC. For the DC's serving more rural areas, most scenarios did not reduce the number of vehicles used, but did manage to reduce the total cost by reducing both driving kilometres and overtime costs. For the urban area DC's, for most scenarios, we reduced the number of vehicles by over 10%, without increasing total driving distance or hours of overtime in the process. Much of this benefit came from simply reassigning ATMs to DCs. However, the new results also had the added benefit of improving the clustering of ATMs assigned to each vehicle. This is helpful, because if an ATM requires an emergency service or even a repair, it helps to know that the team is always nearby, and can get there without too big a disruption to the route.

SUBMIT A FEATURE ARTICLE

The ORSSA Newsletter is an excellent medium for showcasing one's work to the Operations Research community, not only in South Africa, but around the world. There are zero costs associated with submitting an article to the Newsletter and if selected for publication, the article sets the theme for the entire edition. If you would like to submit an article to the Newsletter, please send your article and all associated media (e.g. images, charts, etc.) to the editor at ehorn@sun.ac.za.



Google™
in collaboration with

ORSSA Vaal Triangle Chapter



25 March 2014

16:30 Gather at hubs and connect through Hangouts

17:00 Presentation by David Wertheimer

The Chapter is proud to host its first digital quarterly event. Connect through Google Hangouts to view and interact with our speaker live from the United States or join us at one of three physical hubs in Secunda, Sasolburg and Potchefstroom. Additionally, the broadcast will be streamed through Hangouts On Air.

RSVP to Lieschen Venter at lieschen.venter@sasol.com before 15 March 2014 indicating your preferred method of participation. Connection details will be provided in due course.

The talk

Google is one of the largest manufacturers of computer servers, but rather than selling externally, Google uses them exclusively in its own datacentres. Though manufacturing for self-consumption removes some problems faced by traditional manufacturers, it introduces a whole suite of additional complications and constraints since Google must simultaneously "manufacture" the datacentre space into which the machines are landed, and must coordinate many different classes of constraints and types of forecasts, including platform performance, budgetary, and organic and planned growth. The Global Capacity & Delivery team within Google tackles this with a range of tools, such as linear programming, spreadsheets, & Monte Carlo simulations. After providing a foundation for the problem we are looking to solve, we will cover the types of analysis tools & models used by Google, the types of data & data issues we face, challenges in building enterprise tools, and some considerations on how we prioritize where to focus our planning and modelling efforts.

The speaker



David Wertheimer has 14 years experience in a variety of verticals, all with a decision support emphasis. He started his career leading product management for optimization features in Oracle's Warehouse Management offering. He then joined a boutique consulting & software firm, leading strategic engagements & analytic software deployments to aid display media firms in inventory forecasting, price optimization, and yield management. When the firm was acquired by Microsoft, that revenue management focus was directed inward, where he led a team set pricing strategy and deal compliance for digital media worldwide. Most recently, he is leading pricing and fleet planning efforts within Google, providing a foundation for long term planning and economic decision making amongst the multiple business units. He completed his Masters of Engineering at Cornell University, and has B.S. in both ORIE and Computer Science.

GETTING TO KNOW OUR PRESIDENT: AN INTERVIEW WITH HENNIE KRUGER

Questions by Mark Einhorn

Born in 1955 in the Free State town of Bothaville, Hennie Kruger matriculated in 1973, after which he performed military service as a Second Lieutenant during 1974 and 1975. His tertiary education started in 1976 at the former *Potchefstroom University for Christian Higher Education* (PU for CHE), where he obtained his BSc degree at the end of 1978 with majors in Mathematics and Economics.

During 1979, Hennie was an employee of the Department of Water Affairs in Pretoria and from 1980, he was on the staff of the *University of the Orange Free State* (UOFS), where he worked in the Information Technology department. During this time, he studied part time at UOFS and completed a BSc (Hons) in Mathematics (1982), BCom (Hons) in Information Systems (1986) and MCom in Information Systems (1989). From 1989, he worked for Anglo American at its Gold and Uranium Division in Welkom. During his stay in Welkom, he studied part time again and completed a PhD in Information Systems (1994) at the PU for CHE (with Prof JM Hattingh as his supervisor), as well as an MSc in Mathematical Statistics (1999) at UOFS. While staying in Welkom, Hennie was also a part-time lecturer in Mathematical Statistics at Vista University and the Technikon Free State.

Hennie's academic career only started in 2000 when he was appointed as associate professor at the PU for CHE in the Computer Science and Information Systems subject group. During 2010, he was promoted to the rank of professor. He currently teaches various undergraduate and postgraduate courses in Computer Science and Information Systems with a focus on Decision Support Systems. His research is focused mainly on Decision Support Systems, with some focus on human aspects in Information Security. In 2010, Hennie was accredited by the NRF as an established researcher. Since 2009, he has been responsible for the management of the Telkom Centre of Excellence that funds Computer Science research projects on both the Potchefstroom and Mafikeng Campuses of North-West University, as well as some projects of the Engineering Faculty.

Thank you very much for agreeing to this interview Hennie, and giving our members a chance to get to know their president a little bit better. With that said, let me start by asking you, if I may, what does the ORSSA presidency mean to you?

The ORSSA presidency is, for me, in the first instance an honour. It is an honour to serve the society in a leading role and it is also an honour to follow in the footsteps of past presidents who are all great operational researchers and who were outstanding presidents. The ORSSA presidency also means to me that I have accepted a responsibility to look after all ORSSA matters and (with the help of the Executive Committee) to make sure that our society is operating at a level that we all want it to be, that the society grows and that it remains the preferred society for all South African operations researchers.

What are your visions for ORSSA over the next two years, and what direction would you like to see the society move in?

There are so many important things that we are doing in ORSSA and I think we all would like to make progress in all of them. This might not always be possible and my view is that if we at least try and find the so called "four minute mile" opportunities that I referred to in my column, then we will automatically make progress and grow (that is now in addition to the major breakthroughs!). In terms of moving the society in a specific direction – I think we are doing fairly well and there is no immediate need for major direction changes. One thing that we may want to consider is to "move closer" to technology. One example: Dave Evans has laid a firm foundation for marketing needs and opportunities and maybe we should now take the next step and see how we can utilise technology to assist us with this matter. Surely we must be able to use Facebook, Twitter, LinkedIn *etc.*, in a more intensive way.

In your opinion, what are some of the more important roles that should be fulfilled firstly by the Society and secondly by yourself as president of the Society?

On the official ORSSA website, under the heading "What is ORSSA?" the first sentence states the following: "The Operations Research Society of South Africa (ORSSA) is the national, professional body tasked with furthering the interests of those engaged in, or interested in Operations Research activities." I think this is a good summary of the role of the Society. I see the role of the president then to coordinate and develop (with the help of the Executive Committee and all members) the activities in the society according to the society's aims and objectives.

If we could turn back the clock a bit now, when did you first become involved with Operations Research and ORSSA in particular?

My first real experience with OR was in the early nineties while I was working for a mining company. We had to allocate resources to different regions and we made use of the AHP to prioritise the regions – we then used a loss function that was minimised to arrive at specific conclusions. At that time I did not even know that what we were doing was, in fact, OR!

Although my working career started in the late seventies, my academic career only started in 2000 when I joined the NWU. This was the year that I attended my first ORSSA conference at the Stellenbosch Business School in Bellville and I guess that is where my involvement started.

What are some of the positions you have occupied over the years?

I only had two other positions in the Executive Committee previously. I was an additional member of the committee (I was responsible for liaison with SACNASP) and I was also for a while the Vaal Triangle chapter chairman.

Can you give us an idea of how ORSSA has evolved over the years and whether you see the potential for more positive evolution?

As I said earlier, I have only been a member of ORSSA since 2000, so I would not be able to give a complete account of the evolution over the years. Having said this, even in the relatively short time that I have been involved with ORSSA it is fairly easy to quote examples of how ORSSA has changed and evolved.

There were changes in the Executive Committee over the years, *e.g.* a new marketing portfolio, a database manager, a larger number of additional members, *etc.* All these changes were implemented to streamline the activities of the Executive Committee and to ensure that all matters receive proper attention. The new student medals and the young Operations Researcher award are also new and exciting changes that took place recently. There were also positive developments at the annual ORSSA conferences – the registration and submission of abstracts and papers are handled through the society's website; proceedings with peer reviewed full length papers have been available since 2011; another new feature is the workshop(s) that now form part of conferences to cater for members who need to justify attendance in terms of training courses. Our official journal, ORiON, has also changed over the years (new format, new cover page, *etc.*) and is truly a well-managed and

an excellent research outlet for members. I think in general ORSSA has evolved over the years in almost all areas – I have not even mentioned, for example, the developments that took place at the various chapters, the Newsletter *etc.*, which shows that ORSSA is evolving progressively with time.

Future positive evolution is a given and I think areas where this evolution may take place are mostly related to technology. Social media will probably be used more intensively for communication purposes and marketing. I foresee that our online database will also play a major role in the coming years. Hopefully we will also be able to move, as I mentioned earlier, closer to the industry in the form of sponsorships, joint projects and joint training opportunities.

What are some of your fondest memories as a result of your involvement with ORSSA?

Fond memories are often associated with social events and I think the annual ORSSA conference is such an event. It is always nice to see colleagues and meet other operations researchers and be able to socialise with them. Even the international EURO and IFORS conferences sometimes deliver a pleasant surprise or two when you meet fellow South Africans in a foreign country.

Finally, do you have any parting words or comments for some of our younger student members who are interested in pursuing a career in Operations Research?

I have never come across anyone who is working in the field of operations research who does not enjoy what they are doing. Operations research is an interesting field with an almost infinite number of challenges and applications. In the modern socio-economic times that we are living in there are also new opportunities that we can (and should) integrate with our mathematical techniques and models. Issues such as globalisation, social welfare and poverty, philosophical and ethical issues, corporate governance, sustainable development *etc.*, are becoming more and more important. Maybe this is something that operations researchers (and young people) need to look at.

A final word for young operations researchers: OR is a field that will satisfy almost every decision maker and problem solver as there is such a wide variety of application areas. It gives one great satisfaction and maybe we, as operations researchers, may recognise ourselves in the words of the composer Ernest Newman: "The great composer [operations researcher] does not set to work because he is inspired, but becomes inspired because he is working."

BOOK REVIEW: THINKING FAST AND SLOW

By Hans Ittman (hittmann01@gmail.com)

Operations Researchers are in the business of assisting in the process of making better decisions. However, many decisions are based on the beliefs of the likelihood of uncertain events - how do people assess the probability of an uncertain event or the value of an uncertain quantity? Do we really understand the thinking process of people in making decisions, judgements or choices? In a book titled, "Thinking, Fast and Slow", published in 2011, the author shows how easy it is for us as human beings and decision makers to diverge from rationality and how our ingrained biases lead us time and again to make wrong choices and thus wrong decisions.

The 2002, Daniel Kahneman (a psychologist) shared the Nobel Prize in Economics for his work on decision theory. The prize was awarded to him based on his papers on this topic, most notably those co-authored in collaboration with Amos Tversky. Their collaboration started by chance in 1969, when both of them were in the Department of Psychology at the Hebrew University in Jerusalem. Kahneman writes with affection about his long and fruitful association with Tversky, who was a rising star in the field of decision research when they met. The latter died in 1996, at the young age of 59, and was therefore not eligible for the Nobel Prize.

Kahneman's book is partly an intellectual autobiography and much of what is presented in the book is about "biases of intuition". In addition Kahneman states that what is contained in the book is "his current understanding of judgement and decision making, which has been shaped by psychological discoveries over recent decades". Although one can consider this an autobiography of the author, much of what is discussed and covered in the book, is the work of international researchers.

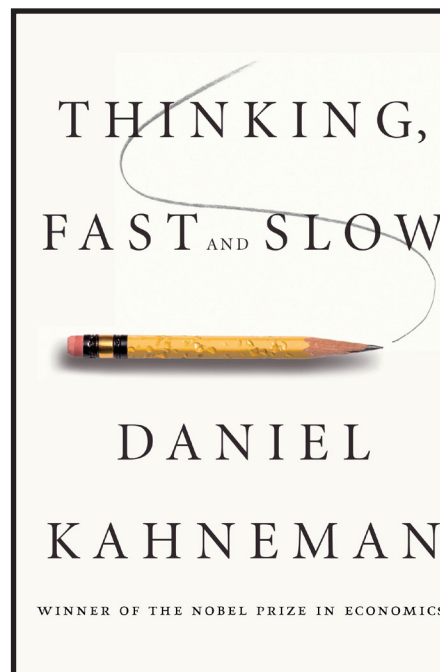
Our thinking process is presented as consisting of two systems, "the characters of the story" almost as in a work of fiction. System 1 (Thinking Fast) "operates automatically and quickly, with little or no effort and no sense of voluntary control". System 2 (Thinking Slow), on the other hand, "allocates attention to the effortful mental activities that

demand it, including complex computations. The operations of Systems 2 are often associated with the subjective experience of agency, choice and concentration". System 2 is therefore conscious, uses deductive reasoning and requires an awful lot of work. System 2 thinks it is in charge but it's really the irrepressible System 1 that runs the show, one that cannot be switched off! This is illustrated vividly by the following example, one of many, given in the book - do not try to solve it but listen to your intuition:

A bat and a ball cost \$1.10.

The bat costs one dollar more than the ball.

How much does the ball cost?



For the majority of people the number that comes to mind is 10 cents. The answer is intuitive, appealing and, yes, wrong!! Use System 2 to do the calculation and you will realise the answer is, in fact, 5 cents.

Another example used frequently in the book is the "the Linda problem". Here participants were told about an imaginary young woman named Linda, single, outspoken and very bright, and who, as a student, was deeply concerned with issues of discrimination and social justice. The participants in the experiment were then asked which alternative was more probable:

Linda is a bank teller; or

Linda is a bank teller and is active in the feminist movement.

The overwhelming response was that the second statement was more probable *i.e.*, "feminist bank teller" was more likely than "bank teller". Of course this is a blatant violation of the laws of probability. Every feminist bank teller is a bank teller and adding "feminist" to the description of the bank teller can only lower the probability. About 85% to 90% of undergraduate students at several major universities chose the second option, contrary to logic. One student, informed that she had committed an elementary logical blunder, responded, "I thought you just asked for my opinion".

Many such (alarming?) examples are giving throughout

the book. System 1 is hopelessly bad at the kind of statistical thinking that is often required for good decisions - it jumps quickly and easily to conclusions. System 1 is subject to a whole suite of irrational biases and interference effects which is covered throughout the book. Many such experimentally demonstrated breakdowns in rationality are described, these include the halo effect, the "Florida effect", base-rate neglect, framing effects, anchoring effects, the confirmation bias, outcome bias, hindsight bias, availability bias, the focusing illusion, *etc.* The cumulative effect of all of this is fairly alarming and despairing for human reasoning.

The book is divided into five parts. Part 1 presents the basic elements of the two-system approach to judgment and choice as presented above. Part 2 addresses the question: Why is it so difficult for us to think statistically? The difficulties of statistical thinking are elaborated on and highlighted in Part 3. Our excessive over-confidence in what we believe we know and our inability to acknowledge this is covered. The key concepts of prospect theory based on the initial work of Kahneman and Tversky, published in 1979, is presented in Part 4. Finally the focus in Part 5 turns to human well-being and happiness. A distinction between two selves is introduced namely remembering self and experiencing self. It is only in recent years that Kahneman has become interested in how people experience happiness and well-being. Following a very similar approach through experiments, very illuminating results have been obtained in this regard. There is a final chapter which *inter alia* includes a bit about what organisations can do to improve the quality of judgements and decisions made on their behalf. Two papers of Kahneman and Tversky, "Judgement under Uncertainty" and "Choices, Values and Frames" are attached as appendixes to the book.

Thinking, Fast and Slow is a truly outstanding book (it was listed under the top 10 non-fiction books of the New York Times for 2011), distinguished by the clarity and exposition of detail as well as the way in which the material is presented. It is impossible to convey the richness contained in the book. Some of the chapters are more taxing than others, the examples and the number of different effects becomes a bit overwhelming, but none of these requires any special background. Having read the book, will this enable us to make better decisions or assist us as operations researchers in helping others to make better decisions? Kahneman is sceptical about even his own ability to change, as he clearly states: "I have made much more progress in recognizing the errors of others than my own". As operations researchers we need to take note of why even experts rely on intuition and often get it wrong. Insight into cognitive psychology is critically important, possibly more so for our discipline, and this book certainly provides that insight. Many good

books have been written on human rationality and irrationality, but *Thinking, Fast and Slow* must rate amongst the best if not *the* best. As one reviewer states: "[the book] is readable, wise and deep. Buy it fast. Read it slowly and repeatedly. It will change the way you think, on the job, about the world, and in your own life."

(The book is currently available in soft cover in good bookstores and is also freely available in electronic format. Just Google "Thinking Fast and Slow" and you will be able to download a pdf version of the book. In addition, a slightly modified version of this book review appeared in the IFORS newsletter.)

Book info: Thinking Fast and Slow by Daniel Kahneman, 2011, Penguin Group, London, England. pp 499, ISBN 978-1-846-14055-6, £15.50.

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 the details concerning conferences, advertisements, *etc.*, appearing in this Newsletter. Members should verify these aspects themselves if they wish to respond to them.

SOCIAL MEDIA

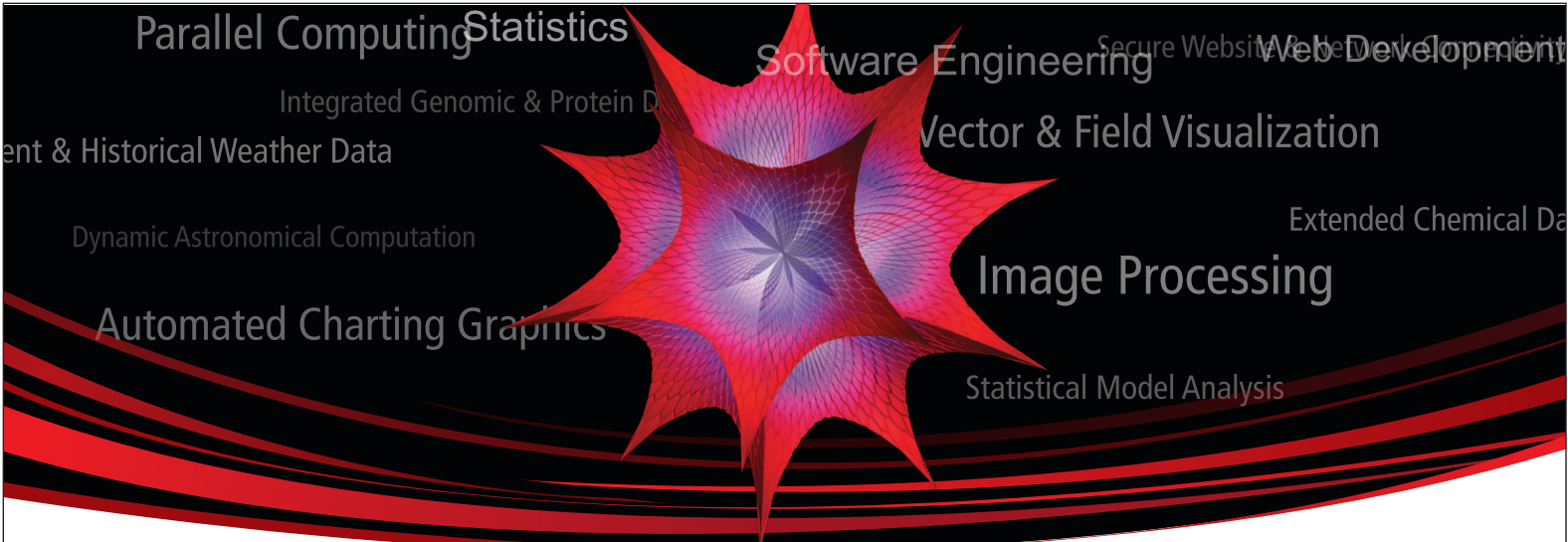
- **Facebook** — Please visit (and like!) our page at www.facebook.com/ORSAocietySA.
- **Twitter** — @_ORSSA_.

IMPORTANT NOTICE

Please note that the Society has recently created a new Standard Bank cheque account for membership payments. The previous Nedbank account will be closing shortly and should not be used for membership payments. The new account details are as follows:

Bank:	Standard Bank
Account Name:	Operations Research Society of SA
Account Number:	330386344
Branch Name:	Potchefstroom
Branch Number:	052838
Swift Code Nr.:	SBZAJJ

Please direct any questions regarding membership payments to our treasurer, Tiny du Toit, contactable at Tiny.DuToit@nwu.ac.za.



Wolfram *Mathematica*[®] 9

400 new features • 9 new application areas • 1 highly integrated system

If you are doing anything technical, think *Mathematica*—not just for computation, but for modelling, simulation, visualisation, development, documentation, and deployment.

Why *Mathematica*? Because this one integrated system delivers unprecedented workflow, coherence, reliability, and innovation. Rather than different toolkits for different jobs, *Mathematica* has been built over 20 years to deliver one vision: the ultimate technical application and environment.

➤ Find out more at wolfram.com/mathematica



Distributed by:

Blue Stallion Technologies
Tel: (011) 447 9916
Fax: (011) 447 9911
info@bluestallion.co.za



AnyLogic[®]

www.anylogic.com

**The only simulation software supporting ALL modeling methods:
Discrete Event, System Dynamics, and Agent Based**

-  Social Dynamics
-  Business Process
-  Pedestrian Dynamics
-  Asset Management
-  Healthcare
-  Manufacturing
-  Supply Chain & Logistics
-  Transportation



Distributed by:
Blue Stallion Technologies
Tel: (011) 447 9916
Fax: (011) 447 9911
info@bluestallion.co.za

MULTI-METHOD SIMULATION SOFTWARE

Optimise your career through research collaboration or by obtaining a degree through the Industrial Engineering Department at Stellenbosch University.

supply chain

LOGISTICS

Push & Pull systems

Facility planning

Inventory management

Packing

Doing it better

Bio-mechanical body parts

MANUFACTURING

Machining

Robotics

Rapid prototyping

Micro milling

Micro injection moulding

Systems dynamics

ANALYTICS

Statistical analysis

Business analysis

Simulation

SYNTHESIS

Optimisation

Planning

Decision support

Economic modelling

MANAGEMENT

Business analysis

Operations management

Knowledge management

Project management

Change management

TIME FOR CHANGE

BEng (Industrial), MEng (Research) or MEng (Structured) (Engineering Management), MEng (Research) or MEng (Structured) (Industrial Engineering), PhD, Postgraduate Diploma in Engineering Management or Industrial Engineering

**Industrial Engineering
@ Stellenbosch University**

www.ie.sun.ac.za