Operations Research Society of South Africa

AT THE FOREFRONT OF ANALYTICS IN AFRICA

# ORSSA Newsletter June 2017

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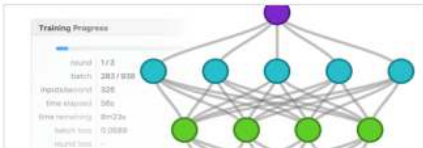
Machine Learning
Neural Networks »

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3D Printing & Geometry
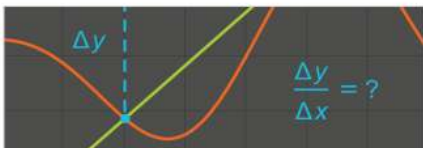**3D Printing »**

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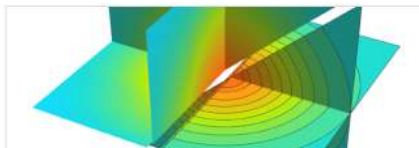
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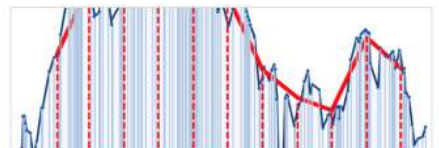
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Text and Language Processing »

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Units & Dates »

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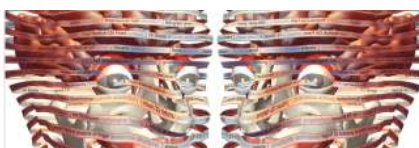
Knowledgebase
Knowledgebase Expansion »

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Cloud & Web Interfaces »

Cloud Storage & Operations »

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From The Editor

By Brian van Vuuren (brianvv@sun.ac.za)

Brian van Vuuren

Dear ORSSA Members

Not to be the bearer of bad news, but we're halfway through the year and you're yet to start on that new year's resolution...

But on a more serious note, time has really flown in 2017 and I trust everyone is making the most of the year thus far!

We have a nice variety of contributions to the newsletter this quarter. As always, thanks to everyone who contributes content. A special thank you must go to Hans Ittmann who provides a book review for each and every edition of the newsletter we put out, as well as to Prof Jan van Vuuren who loyally (and thoroughly!) proofreads the newsletter, as well as makes layout suggestions, every quarter. It really is a team effort and I appreciate all those involved in some way, shape or form!

You'll see some nice feedback regarding activities within the different ORSSA chapters in this edition. I encourage you, if you don't already, to try and attend chapter events. They're a great way to meet fellow ORSSA members and stay in the loop with what's going on in the field of OR from a range of different perspectives. Furthermore, the Pretoria and Johannesburg chapters have kindly provided us with some of their content from their 'Lean Meetups' which have been a huge success in their respective chapters. Why not make use of it and start up a meetup in your own chapter?

I also catch up with this year's marketing manager, Denzil Kennon. He's not a familiar face in ORSSA, so I encourage you to read the interview so that you have something to chat about over a beer at the upcoming conference (he's buying apparently...). There's also a somewhat 'tongue-in-cheek' article looking back at some of the statistics gathered over the course of 2016 written by yours truly. The views expressed are purely for entertainment value — please read the article with the jest and light-heartedness with which is was intended.

Not much else remains to be said other than I hope you enjoy this issue and I look forward to seeing the ORSSA community at the upcoming conference in September.

Until then,
Brian

Features

SOCIAL MEDIA

- **Facebook:** Please visit (and like!) our page at *www.facebook.com/ORSocietySA*
- **Twitter**: @_ORSSA
- **LinkedIn:** Please visit our page at *www.linkedin.com/company/the-operations-research-society-of-south-africa*

The continued struggles of the dating mathematician...
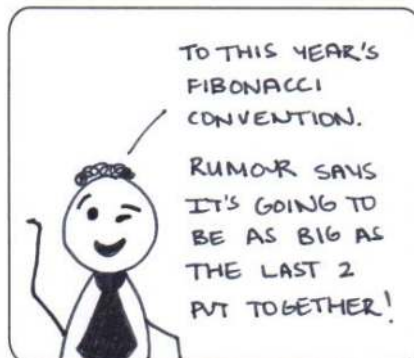
2017 ANNUAL ORSSA CONFERENCE

CHAMPAGNE SPORTS RESORT

CENTRAL DRAKENSBERG

CONFERENCE DETAILS

Sunday, 10 September 2017
Optional Tutorial hosted by IBM

Monday, 11 September 2017
Conference Day 1

Tuesday, 12 September 2017
Conference Day 2

Wednesday, 13 September 2017
Conference Day 3 (until lunch)

ABSTRACT SUBMISSION

Closes 14 July 2017

Submissions covering the full Operations Research specturm are encourgaed with emphasis on topics of a more fundamental OR nature, application of OR techniques in business & industry, topical issues in OR and the philosophy, teaching and marketing of OR.

MORE INFORMATION

For more information, as well as accommodation options, please visit the ORSSA website at:

www.orssa.org.za ⟶ ORSSA 2017

KEYNOTE SPEAKERS

Susara van den Heever
Opening Keynote & Tutorial
IBM Decision Optimization

Riaan de Jongh
Closing Keynote
NWU Centre for BMI

BLUESTALLION technologies

INDUSTRIAL ENGINEERING
Stellenbosch University

Department of Logistics

OPSi SYSTEMS

Centre for BMI
Senteramo ya DII
Sentrum vir BWI

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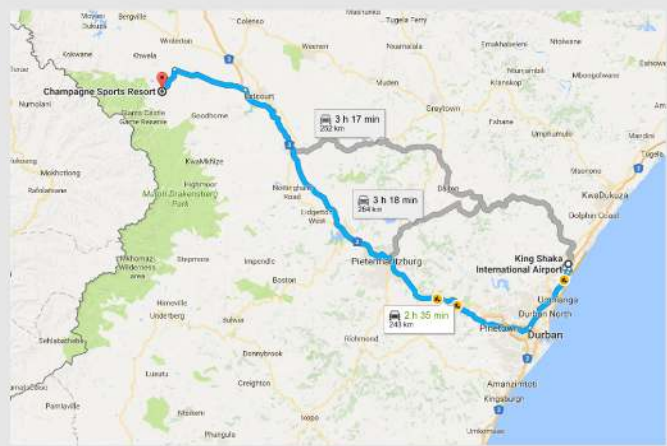NOORDWES-UNIVERSITEIT
POTCHEFSTROOM CAMPUS

PIVOT SCIENCES

UNISA
college of economic and management sciences

CONFERENCE VENUE

Champagne Sports Resort
KZN, South Africa

KEYNOTE ABSTRACTS

"OR is dead. Long live OR!"

– Dr Susara van den Heever

"Unless the field of Operations Research (OR) goes through a radical transformation, it has no future." This is what some stated back in the 1970s, declaring OR just short of officially dead. However, contrary to these 1970 beliefs, we now know that not only did OR survive as a discipline, but that the need for transformation during that time led to a period of unprecedented innovation and growth in the OR community, as well as related technologies.

Theoretical innovations, in combination with new computers solving models faster, meant that OR expanded from military usage, to being applied in nearly all industries today, including aerospace, manufacturing, banking, energy and utilities, supply chains, finance, and mining, to name a few. This same phenomenon is happening again today. Amidst scepticism about the survival of OR in the new Data Science wave, the rise of cloud computing means OR can solve larger decision-making problems, do this in a more cost-effective way, and bring the benefits to a much wider market. The rise of Big Data means OR practitioners have access to higher volume and more accurate data, which in turns means optimisation-based plans and schedules become more robust, reliable, and reactive, than ever before. The rise of cognitive capabilities, means Line-of-Business end-users can interact with optimisation-based applications in their own business language, to tap even more value from this powerful technology. Instead of a question of survival, this is now a question of unlimited potential. In this talk, I elaborate on how recent advances in IT and Data Science is accelerating the evolution of the OR discipline to a band new level.

Professional OR training and research programmes in finance

– Prof Riaan de Jongh

In 1978, when I first became involved in the field of Operations Research (OR) in the military environment, OR was considered to be a multi-disciplinary field where problem solving should be conducted in an inter-disciplinary way. At the same time the first desktop computers became available, which enabled the implementation of mathematical algorithms. Back then, OR was very much considered as a field concerned with problem solving, having its roots in the mathematical and computer sciences.

As a young man with aspirations to become a professional in this field, I was often disillusioned by the lack of acknowledgement the field enjoyed by industry and the general public. At the time, I felt that academics operating in this field often failed to address the real world problems that they were confronted with. This was mainly due to a lack of willingness or ineptness to address and formulate the real world problems properly. Of course, there were always a few exceptions!

The emerging field of Big Data and Data Science is currently disrupting business in most industries, particularly in finance. In my opinion, this field is similar in many ways to early OR and presents many new opportunities for OR practitioners.

In this talk, I will draw some parallels between early OR and Data Science, and demonstrate why the original OR principles should be considered in the design of training and research facilities, in order to make it particularly suitable to address the challenges posed by the Big Data / Data Science field.

From The President's Desk

By Winnie Pelser
(winnie.pelser@gmail.com)
ORSSA President

Winnie Pelser

The June edition of our Newsletter is the last edition before we meet for the 46th Annual Conference. The conference will take place at the Champagne Sports Resort in the Central Drakensberg, KwaZulu Natal from 10 – 13 September 2017. Preparations for the conference are underway by the Local Organising Committee (LOC) led by Fanie Terblanche. Details of the conference can be found on the ORSSA webpage (www.orssa.org.za).

The LOC has secured a number of sponsors for the conference. I would like to thank both the LOC for their efforts and the sponsors who have agreed to support the conference. Sponsors so far include the Departments of Industrial Engineering and Logistics at Stellenbosch University, the Department of Decision Sciences (UNISA), Pivot Sciences, Blue Stallion Technologies, OPSI Systems and North-West University's Centre for Business Mathematics and Informatics.

The conference keynote speakers this year will be Susara van den Heever and Riaan de Jongh. Dr Susara van den Heever is the Program Manager of Offering Management for IBM Decision Optimization, within IBM Analytics. She is passionate about bringing the power and benefits of advanced analytics to real-world solutions, by making analytics more understandable, consumable, and enjoyable. Prof Riaan de Jongh is the Director at the Centre for Business Mathematics & Informatics, North-West University. He played a leading role in the establishment of world-class career oriented training and industry directed research programmes in financial risk. More detail of the speakers can be found on the ORSSA 2017 Conference website under 'Keynote Speakers'.

Delegates are invited to an optional tutorial on 10 September. The tutorial is presented by the IBM Decision Optimisation Centre. It will cover a brief introduction on how to create an Optimization Application using IBM Decision Optimization Center.

Registration for the conference is open and interested people are encouraged to register and organise their accommodation as soon as possible. Early bird registration closes on 31st July 2017. Abstract submission is open and closes on 14th July 2017. The registration deadline is 18th August 2017.

The different chapters are active and regular meetings are being held. I would like to thank the chapter chairs, chapter committees and all members who organise and attend the chapter events. The Meetup groups are continuing and members are encouraged to support these meetings. Meetings are regularly held by the Johannesburg, Pretoria, Vaal Triangle and Western Cape chapters.

Statements of payable membership fees were sent out with the March Newsletter and I would like to encourage all members to settle their membership fees. In some instances payments are overdue and I would like to request your assistance with these payments to help ensure that the Society has the funds to continue delivering a valuable service to its members. Enquiries about the statements or any other financially related matters can be directed to Dave Evans the treasurer, and Gemma Dawson the Database Manager. Their contact details are available on the website. In conclusion, I want to thank every ORSSA Member for their contributions to our Society. Thank you to every member of the Executive Committee for managing his or her portfolio in a professional way under severe work pressures. Please feel free to contact me, or any member of the Executive Committee should you have any request or ideas that could help us to improve the Society's service to its members.

With best wishes until we meet in the Drakensberg,
Winnie Pelser

Quarterly Puzzle: *The Virus Riddle*

Provided by Shane van heerden (17683068@sun.ac.za)
Adapted from Lisa Winer (TED-Ed) and Jay Bennet (Popular Mechanics)

Shane v Heerden

Let's set the scene: You are leading a scientific expedition in the frozen wastelands of Siberia.

Your research group has just stumbled upon a prehistoric virus perfectly preserved in the permafrost. Overjoyed by this discovery, you and your team swiftly head back to the base camp lab to contain the virus.

After a long night's work, you successfully isolate the virus in a series of 15 test tubes for study, each of which is stored in a separate room. Upon leaving the lab, a sudden earthquake rocks the surrounding countryside. After the

tremors cease, an alarm sounds indicating that all of the test tubes have been shattered, contaminating the rooms.

The lab consists of 16 rooms arranged in a 4x4 configuration, as shown in the figure. The entrance is located in the north-west corner and an exit at the south-east corner. Each room is connected to the adjacent rooms by airlocks. Only the entrance and exit rooms are connected to the outside. A noxious chemical gas has been released in every room except the entrance room, and in a short time, the lab will automatically vent the rooms out into the world, releasing a deadly plague.

You spring into action and don your hazmat suit. To destroy the virus samples, you must enter each contaminated room and pull its self-destruct switch, destroying the room and the virus within it. But there's a problem — because the lab is in lockdown mode, once you enter a contaminated room, you cannot exit a room without activating the self-destruct switch. Furthermore, once the self-destruct switch has been activated, you cannot re-enter that contaminated room.

The official rules and restrictions are as follows:
1. You must enter the building through the entrance and leave through the exit.
2. Every room except the entrance is contaminated.
3. Once you enter a contaminated room, you must pull its self-destruct switch.
4. After pulling the self-destruct switch, you must immediately leave the room.
5. You cannot return to a room after its self-destruct switch has been activated.
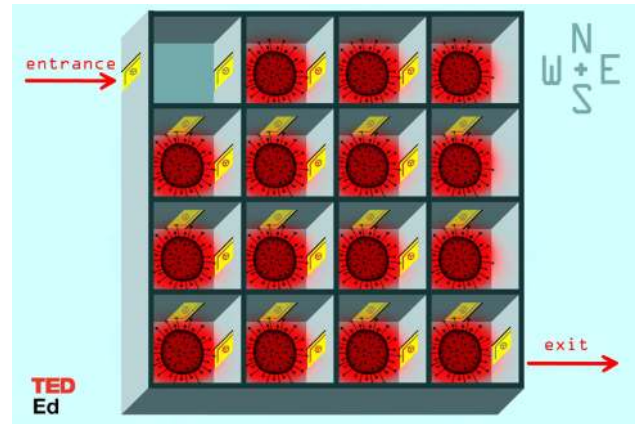
The question: **What path should you take through the lab which allows you to pull the emergency switch in every contaminated room before exiting the lab?**

HINT: *The notion of a Hamiltonian path may come in handy.*

(*The solution to this puzzle is provided on page 17*)

GETTING TO KNOW THE EXEC: DENZIL KENNON

Compiled by Brian van Vuuren (brianvv@sun.ac.za)

Denzil Kennon

Denzil Kennon (*dkennon@sun.ac.za*) was elected onto the ORSSA executive committee at the end of 2016 in the role of marketing manager. Although not a familiar face within the ORSSA community, his election into the position came with the intention of boosting ORSSA's professional profile and consequent membership — something which Denzil has managed to successfully achieve in his association with the *South African Institue for Industrial Engineers* (SAIIE) in years gone by. I met with Denzil to ask him a few questions in an effort to get to know him better, as well as hear his expectations and plans for his role on the executive committee.

What is your academic and professional background?

I obtained my bachelors and masters degrees in Industrial engineering at Stellenbosch University.

Thereafter I started my career at Allan Gray as a business analyst (the title which I am sure OR practitioners know quite well) to focus mainly on risk management initiatives

aligned within the strategic directives department. I wanted to continue my growth in the financial industry, but I wanted a bit more influence over the businesses I wanted to invest in. This is not as possible with JSE listed companies as it is with SMMEs.

I thus embarked on a new career in the Private equity industry in Cape Town focussing on the cattle-, platinum-, gold- and telecommunications industries in Sub-Saharan Africa.

A business partner and I wanted to start our own venture, and on the back of that we started pursuing our PhDs. I now work as a lecturer and researcher at the Department of Industrial Engineering at Stellenbosch University.

How did you get involved with ORSSA?

Real answer: I was asked whether I would act as marketing executive by Danie Lötter and Prof van Vuuren.

Newsletter answer: I first noticed the society four years ago when confronted by the SUnORE group at Stellenbosch University. I have always been a fan of the field of

operations research, especially the fact that it is becoming increasingly important to make sense out of the 'perceived' white noise of data out there.

I keenly followed the progress of the society and, last year, was asked to contribute to the awareness of the society and OR practioners. And that is how I find myself here.

What is your perception of the society thus far? (if any)

Firstly, I am beyond baffled at the amount of time that is volunteered by members in the society and, more specifically, the executive.

Secondly, I find that everyone has been extremely helpful in getting me up to speed. The society is quite a selfless one with people who are really engaged in the field of study. The coffee meetups is something that really impressed me, especially the frequency and attendance. The push from the Pretoria and Johannesburg Chapters have been an eye opener.

What do you envision for the marketing portfolio?

I ran a survey in order to find out what the previous marketing ventures attempted and to find out what the executive might find helpful in the future of the endeavour.

Through this, the role of marketing felt like it should follow three distinct steps:

1. Market, to members, the value that their membership holds for them;
2. Market in order to reach new markets and thus obtain new members; and
3. Market so that industries have a clearer understanding of the role that OR practitioners can play in their organisations.

The focus thus far has been on creating a more visible presence between chapters, regarding the events that are being held. This is being done through Twitter (@_ORSSA) and

Facebook (ORSSA - Operations Research Society of South Africa). I use these platforms to also give non-members a snapshot of the type of access membership gives them, *i.e.* job opportunities, chapter workshops/events, etc. This will be the main focus this year, to lay the ground work for future marketing executives to build on.

Any exciting marketing ventures in the pipeline?

I am working on a paper in which I would like to give ORSSA members, and more specifically, SAIIE members, a snapshot of what OR practitioners (much like the ones who constitue the membership of ORSSA) look like, where they work, which industries they work in, how much they earn, etc. I would like to submit a journal/conference paper to the SAIIE conference in order to provide a real picture of the OR practitioner.

This type of information will create, firstly, a view of where OR is in South Africa, but also provide marketing material going forward. I feel that a lot of questions that we have from learners, students and organisations can be answered through this.

We have done another similar paper for industrial engineering (*headed by Prof CSL Schutte and supported by myself and Wouter Bam*) which has gained traction academically as well as material which I have often used for marketing purposes at the Industrial Engineering Department at Stellenbosch University.

What are you most looking forward to about being part of ORSSA this year?

I have heard that the conferences are quite a lot of fun!

It would be great to meet more of the members across South Africa (and hopefully some of the neighbouring countries too) as my exposure has mainly been to the Western Cape Chapter.

Twenty Sixteen - By the Numbers

Written by Brian van Vuuren (brianvv@sun.ac.za)

We may already be approaching the halfway mark of 2017, but memories of what was a 'jaw dropping' year gone by still burn brightly in my mind. Whether you're a sportsperson, interested in politics, current affairs or just the general ongoings of the world – 2016 surely stands out as a bizarre year in which, quite frankly, a statistically 'impossible' combination of events occurred within 365 short days.

Every time I thought it couldn't get stranger – it did! From unbelievably unlikely occurrences, to stats ranging from the shocking to the amusing – it real-

ly was a year worth reflecting on. I'd like to take you on a short tour on some of the most eye-opening and interesting numbers relating to the year that was.

For starters, 2016 saw an unprecedented number of 28 ongoing global conflicts! When considering that there are about 196 countries in the world and with a conservative estimate saying there are 30 countries involved in totality in those conflicts; that translates to almost 15% of the world's countries being in some kind of war! In stark contrast, only a single peace treaty was signed during

Brian van Vuuren

2016 – that between Colombia and the FARC rebels which was aimed at ending Latin America's longest war. Astoundingly, there were 2 465 recorded languages in the world as of 2016, according to the UNESCO database. Interestingly, when searching this database, no hits are found for 'Afrikaans', however, 'Cape Khoekhoe' turns up when navigating the 'language map' towards the Western Tip of Africa — a language with an affectionate alternate name, according to the database, of 'Cape Hottentot'.

Back in a more native tongue, 843 new words were added to the Oxford English Dictionary during 2016. Although exciting to see a language grow and develop, a browse through this list causes the heart to sink slightly at the sad state of the human condition upon encountering the new entries such as, "Brexit", "YouTuber" and "touchy-feeliness" (*in no way intended to be associated with one another*).

Politically and economically, there were some exciting statistics — 2016 saw 16 active female heads of state. This is accompanied by a rise from 11.7% women occupying parliamentary seats worldwide in 1997, up to 22.7% mid-way through June 2016. This off the back of Saudi Arabia being the last country in world to officially allow women to vote in 2015.

That said, the world still (archaically) sees an unequal split between gender incomes, with the 2016 median incomes in the US showing females earning only 82.9% of male median figures (it should be noted here that the USA is notorious for being one of the worst 'equal pay' endorsing countries worldwide). Encouragingly, however, this statistic is up from 62.7% in 1979. This is accompanied by the listing of 21 female CEOs of Fortune 500 companies which is, unfortunately, a reduction of 4% from 24 companies in 2015. This was in light of Carol Meyrowitz and Ellen Kullman retiring from TJX (Retailing) and DuPont (Chemicals) respectively.

America saw an uncanny 1 788 people register with the Federal Election Campaign to run as the 2016 presidential candidate, including some memorable named entries such as 'Dat Ass', 'BushDid 9/11' and '@lolmynameisjon'. But surely none more ridiculous and outlandish than 'Donald Trump'? (*Falling nicely in the list, nestled between 'Don't vote for Trump' and 'The muslim dictator Trump' — seriously, these are all registered American presidential candidates…*).

Other eye-opening statistics recorded 18 'critically endangered' species worldwide as of 2016. These include a variety of the familiar rhino, gorilla and tiger species. Not far behind these animals on the 'endangered' list, a few very surprising species pop up: the Blue Whale, the chimpanzee and the African Wild Dog are, sadly, all under threat of extinction. Worldwide, 7 100 migrant deaths were recorded (with probably many more going undocumented) amid 21.3 million registered refugees. This in contrast to 147 183 065 babies being born in throughout the year — that's a lot of mouths to feed. Perhaps they could be assisted by the highest paid athlete in the world? Christiano Ronaldo who pocketed a cool $88 million for his services on the football pitch in 2016.

Other notable statistics include:

- **50 million** – the number of trees planted in India on 11 July 2016 in light of a commitment made by India at the Paris Climate conference to reforest 12% of its land. This edged out the previous record set in Pakistan in 2013 by a *narrow* 41 512 247 trees.

- **45** – the number of failed attempts by the Lebanon parliament to elect a president. The country spent 2 and a half years without a head of state until 81 year old Michael Aoun was elected on 31 October.

- **108** – the number of years between 2016 and the last time the Chicago Cubs won a World Series. They defeated the Cleveland Indians in Cleveland on 3 November.

- **540 million** – the number of miles away from which NASA received a signal from its Juno spacecraft. This confirmed that Juno had successfully started orbiting Jupiter after being launched nearly 5 years prior.

- **266 000** – the number of times the distance between the Earth and the sun is the distance between the Earth and 'Proxima b'; a rocky planet discovered in our solar system which may potentially be habitable for humans.

If you were the betting type and threw a bit of caution to the wind, 2016 could have proven to be an astoundingly profitable year for you. In sport alone, a number of uncanny upsets and surprises occurred:

- Novak Djokovic, the then world number 1 male seed who held all 4 grand slam titles at the time, was bundled out of Wimbledon by Sam Querrey – an American who fell 28 positions behind him in the seedings. A R100 bet on this third round upset would have earned you a quick-fire R800 to go with that smirk of seeing the Serbian receive his first major defeat since the French open final in 2015.

- The Welsh football team turned the Euro tournament on its head with their unexpected success at the EURO 2016 football tournament. Although the Iceland team stole most of the show, the low seeded side overturned the second best football side in the

Here's to hoping, for the sake of America, that Trump is more than just a pretty (pronounced 'silly') face.

world, Belgium, 3-1 in their quarter-final tie, before going down 2-0 to eventual winners, Portugal, in their semi-final. That said, backing the dragons with a R100 bet would've scored you a cool R5000 pay-out at 50-1 odds on their impressive performance.

- It may seem like a strange thing to bet on but, at its highest, a R100 bet on Britain actually leaving the EU would've earned you R500 in returns when the Brits eventually went through with the highly publicised 'Brexit'. That said, by the end of it, you'd probably have been willing to pay R500 just not to have to watch another news report about the whole saga.

- It's not everyone's cup of tea to watch, but, if you had the desire to sit through 3+ days of Masters golf, you'd have pocketed a hefty sum by putting your money on Danny Willet. Heading into the tournament, it had been 20 years since there was a British Master's victor — it's hard to believe that anyone would've cashed in on the 70/1 odds offered on Willet ahead of the competition. Even on the final day, going into the final round, you still could've seen returns of R2000 on a R100 bet. But, against those odds, the Yorkshireman fired a bogey-free 67 final round to pip Lee Westwood and Jordan Spieth and claim first place. Reportedly, one lucky 'punter' did put £300 (approx. R6150 at the time) on Willett's unlikely success and, at odds of 60/1, he probably felt like he'd won his own little version of the Masters, gathering returns of £23 000 (R471 500 at the time) for his efforts and good faith.

- Another unlikely bet to be placing was that of Donald Trump becoming president. In terms of odds, those against Donald peaked early in the election campaign where, if you'd placed your R100 in favour of the tangerine machine, he'd have earned you a 'uuuuuge return sum of R15 000 for your good faith. And, as with the world's jaws and hopes for America's future, odds against a Trump victory fell as the campaign continued and he emerged as one

of the two candidates to contest the presidency, but – even right at the end – you still could've doubled your money to bet on America doing the unthinkable and voting him into office. Long live 'Murica!

- But perhaps even Martin Luther King Jnr would've agreed that the most jaw-dropping and unlikely occurrence of 2016 had to be that of Leicester City's victory in the English Premier League. Even if you're not a soccer fan, you couldn't help but get behind this Cinderalla team as they edged closer and closer to the most unlikely of triumphs. Well, had you put your money where your heart was, you could cashed in – big time. And, reportedly, 24 die hard supporters finally had their day. The smallest bet on Liecester was 10p (about R2.50 at the time) which, against the 5000/1 odds offered at the beginning of the season, earned an astonishing £500 (approx. R11 400) in return.

Surely the very definition of a so-called 'Golden Ticket'?

Other payouts reported by betting company 'Ladbrokes' included a £50 000 and £25 000 payout for a £10 and £5 bet, respectively. In total, the betting franchise reportedly paid out £3 million in prize money which, according to a representative, is nothing like they've seen in 130 years of taking bets. The highest reported single payout was £200 000 (+- R4.4 million) paid out on a £100 bet which was made in October 2015 when Claudio Ranieri's side where up to 2000-1 odds in the league. And, as with all winners, there were some 'losers' to (although losers doesn't seem like the right word in this case – perhaps lesser-winners?). There were initially 47 bets placed on Liecester victory at the beginning of the season, but 23 gamblers got cold feet at some or other stage of the season and grabbed their winnings while they could. One anonymous bettor took a £70 000 (R1.6 million) payout in March off the back of his £50 pre-season bet. Not a bad payday at all, but it must surely sting just a little knowing that, had he held out and backed his team, he could've pocketed R5.7million come season end…

So, all in all, a rather bizarre year. A lot to celebrate but, perhaps, even more to worry about. And then there are those who cashed in on the seemingly impossible

to which we shake our heads. But, whether you're a stats person, a gambler or just love numbers, you can't help but enjoy a world neatly summed up in numeracy.

To close, perhaps you're left to wonder what the most unlikely successful bet ever was? Well, I didn't research too deeply, but in 2001, an Englishman named Mick Gibbs reportedly laid up a measly 30p (R1.33 at the time) on an insane 15-match parlay. In order to win a parlay, you have to pick 15 events

correctly. In this case, Gibbs picked the winners of 15 soccer matches. The odds of his selected teams indeed winning them all? A staggering 1 666 666/1.

And, after he correctly called the first 14 matches, all that was left was or Bayern Munich to defeat Valencia in the finals of the 2001 Champions League (which they did – German reliability) to earn Gibbs an uncanny payout of approximately £533 500 (R7.096 million).

The ORSSA Western Cape Chapter Event: A Wolfram Tutorial

Written by Mattie Landman (12345678@sun.ac.za)

Mattie Landman

On the 6th of May, Clemens Dempers from Blue Stallion Technologies presented a workshop at Stellenbosch University, which formed the second Western Cape Chapter event of the year.
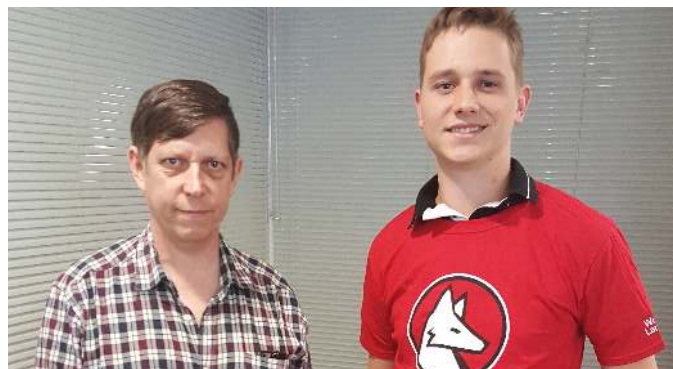
In this workshop, entitled *Solving complex operations research problems using Wolfram Mathematica – A hands-on workshop*, attendees were introduced to the Wolfram language and a host of capabilities of Wolfram Mathematica 11.0 in the context of Operations Research.

The Wolfram language is a knowledge-based language, where information of both computation and the world are built into the language. Clemens, focusing on its use within Mathematica, showed that the core significance of the language was its symbolic structure and its coherence of algorithms, knowledge and data. This leads to high performance computing and maximum flexibility and use. Even Apple's digital secretary, Siri, has climbed on board with the use of Wolfram Alpha, an answer-engine developed by Wolfram Research.

During the workshop various capabilities of the language were explored as well as its applications to case-specific problems. Among others this included the use of the language within the machine learning platform with text recognition as an example.
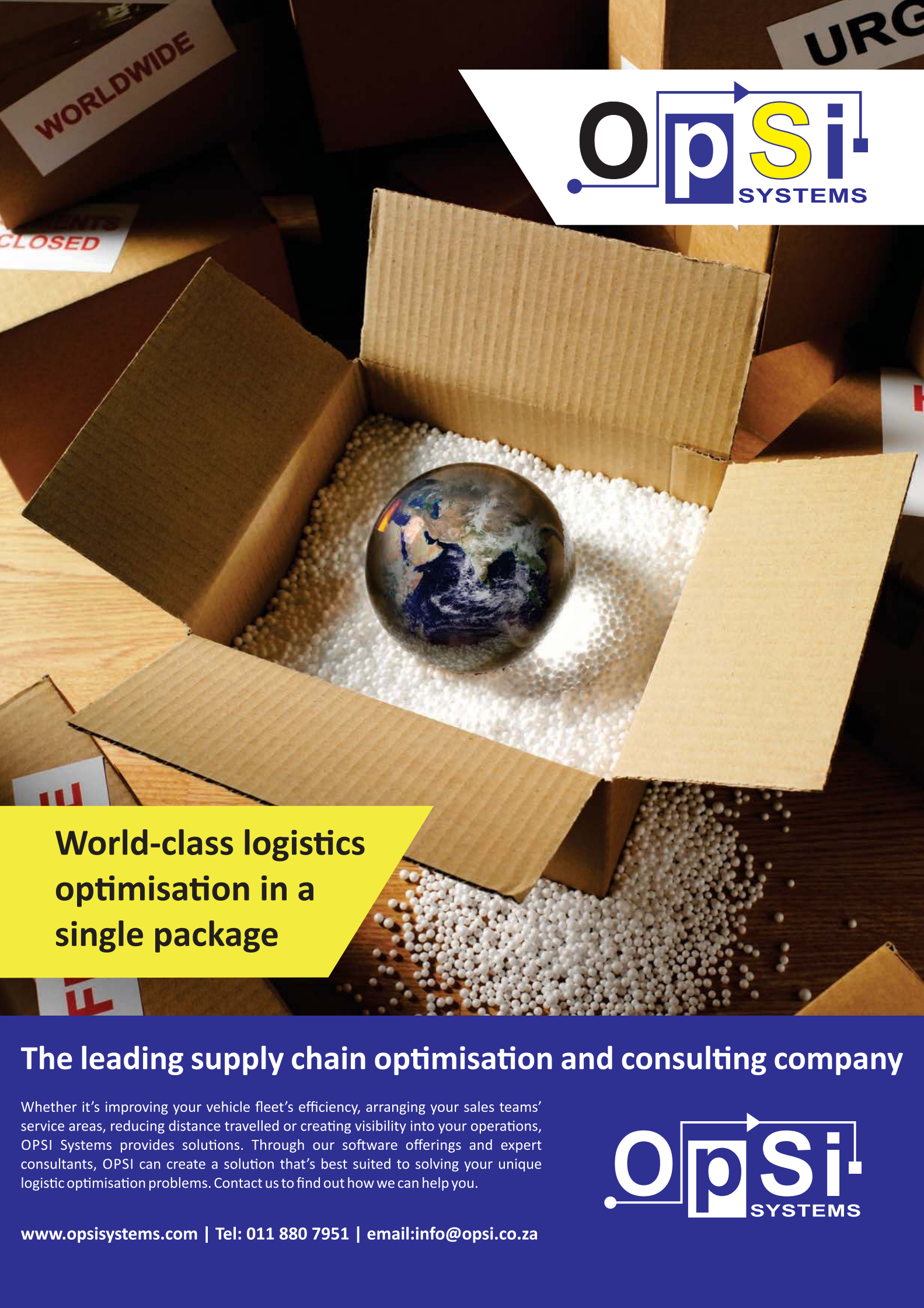

Tutorial presenter, Clemens Dempers, with ORSSA Western Cape Chapter Chair, Shane van Heerden

The Wolfram language also has the best-known algorithms for solving the travelling salesman problem, and with the use of its Geo computation and visualization databases the problem can easily be applied to real-world location problems.

Building on its strong graph capabilities, social networks were shown to be easily analysed using the language. Social networks are accessible from various sources including from databases and direct social media (Facebook or Twitter) accounts. The language makes it easy to discover communities, important actors and visualize the results.

The attendees of this event were given the opportunity to become acquainted to the basic structure of the language and its notepad-based user interface with a hands-on tutorial by Clemens. Each attendee was also given a 30 day trial licence supplied by Blue Stallion Technologies to further explore the capabilities of Wolfram Alpha. Members were also treated to various Blue Stallion merchandise, finger-foods and a sit down lunch. Overall, the workshop proved to be an informative and enjoyable chapter event.

On behalf of all the Western Cape Chapter members, we would like to thank Clemens and Blue Stallion Technologies for making this possible.

Various examples were worked through during the tutorial

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

Doing it better

LOGISTICS

Supply chain

Facility *planning*

Push & Pull *systems*

Inventory *management*

Packing

MANUFACTURING

Bio-mechanical *body parts*

Machining

Robotics

Micro *injection moulding*

Micro *milling*

Rapid *prototyping*

ANALYTICS

Systems *dynamics*

Statistical *analysis*

Business *analysis*

Planning

Simulation

SYNTHESIS

Optimisation

Decision *support*

MANAGEMENT

Economic *modelling*

Business *analysis*

ANALYSIS

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Knowledge *management*

Change *management*

TIME FOR CHANGE

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LEAN ANALYTICS MEETUPS (PRETORIA)

by Quintin van Heerden (quintin.vh@gmail.com) & Sumarie Koetsier (sumarie.koetsier@gmail.com)

Quintin v Heerden

From the organisers:
The ORSSA Pretoria Lean Analytics Meetup group was founded on 5 July 2016 and we have since had 18 successful forthnightly meetups at Aroma in Hatfield. Attendees to these events include students, academics, full time employees and freelancers (a Dutch exchange student even attended one meetup). The Lean Coffee format works well as we are normally between 5-8 attendees with about 3-5 topics that are discussed, bar the one meetup where only one topic was discussed, which eventually exploded into a plethora of related topics that all contributed to the main idea. We are looking forward to more fruitful discussions in the company of passionate people while drinking excellent coffee.

- Quintin and Sumarie

Summary of some of the topics discussed:

- Reproducibility of work: How generic should your code/solution be to reproduce it in future?
- Vehicle routing problems and marketing thereof: How can you package solutions to get clients on board?
- Dealing with high dimensional data
- General Electric announces that all new employees should learn to code: wise or a waste of time?
- Freelance work versus permanent employment
- Blockchain accessibility and inclusiveness
- Choosing a good OR topic for a mini-dissertation
- What is Lean Analytics and how do you apply it?
- Is the world ready for AI: Ethical considerations of AI
- Hardware requirements for Data Science / Operations Research use cases
- Hardware *vs* Cloud implementations
- Infographics and data communication
- Kaggle teams: Individual vs team entries
- Cities in motion: Transport modelling, traffic modelling, garbage truck modelling, agent-based modelling
- When to optimise and how to determine when to optimise
- Packaging your solution in an accessible way
- Professional registration: Why should one register (or not), whether it is really necessary, registrations within the IT and CS domains?
- Risks in projects: How to detect early risk signals, what to look out for, creating checks and balances, validating, project management
- The use of imagery and video feeds: Farming with video, satellite imagery, remote sensing, using drones
- The use of social media: Twitter, Facebook, Slack

Sumarie Koetsier

- GPU *vs* CPU processing
- Training neural nets
- Microsoft Team Data Science Process
- Chatbots
- The *Certified Analytics Professional* (CAP) certification
- Scheduling in various domains
- Forecasting
- Game Theory
- Why are there so many "new" metaheuristics?
- Pressure to publish
- Should programming, OR, other analytical skills be taught as part of more degrees?
- Full time *vs* part time studies (especially at PhD level)
- Simulation packages with good GIS capability
- Cryptography and privacy
- How often are constraints non-linear in practice?
- Choosing the right programming language/tool for the job
- HR automation
- High resolution settlement layers
- Machine learning in the cloud
- Image processing using different techniques like colours and buffers
- The rise of the data scientist: Specialising in data science *vs* domain specialisation
- Productivity apps
- EDTEC (Educational Technology): Using technology to visualise mathematical concepts in order to enhance learners' understanding of difficult concepts
- Quantum Machine Learning summer school
- Hadoop and data process scalability
- What is the most difficult/time consuming step in the OR process?
- Community engagement in problem solving
- Value proposition of ORSSA
- Professional registration for data scientists
- Geographical maps, networks, schematics
- Data formats, management, storage
- How to protect organisations against black swan events
- How can we convince the public to share their personal data to enhance research?
- How can we promote data science in South Africa?
- Alternative communication systems, like VoIP (Voice over IP).
- Interaction of AI with the human brain
- Simulation optimisation
- Data science *virtual machines* (VMs)
- Music recommendation software
- Is Operations Research education adequate?

First of all, I want to thank you and Sumarie for your organisation and enthusiasm. For me the meetup events are interesting in many ways. We get to know our fellow practitioners and get insight from their different application areas and methods. It creates opportunities and fosters OR interest in an active manner. It really is a valuable platform.

Winnie Pelser
CSIR, Defence Peace Safety and Security
Industry: Defence

I attend meetups because I like to keep in touch with the challenges that OR practitioners are having in industry. I like the format of the meetings, it's fun discussing trends and technology with others and the coffee at Aroma is great.

Katherine Malan
UNISA, Department of Decision Sciences
Industry: Higher Education

The Lean Analytics Meetups are a relaxed way to network with like-minded professionals. Since everyone comes from different backgrounds, the discussions surrounding the topics are always interesting. It's a great place to share research ideas and get advice regarding the best solution/tools/techniques to technical problems. I would recommend it to anyone with a passion for analytics!

Sumarie Koetsier
CSIR, Built Environment
Industry: Spatial Planning

I see the meetups as an opportunity to soundboard and bounce ideas off others and get solutions for difficult work-related problems. In these Meetups, I learned a lot from the other people and discussed interesting real-world business cases and different solutions for these. It is a great networking opportunity with new people who discuss interesting topics/problems. The other benefit of the meetup is the venue (Aroma) - you start your day with a delicious cup of coffee.

Janelle Botha
Company: Britehouse
Industry: Business Analysis / Data Analytics

As a newcomer to the Operations Research and Analytics industry, the Meetups provide me with valuable insight into practical problems and solutions from experienced individuals.

John Snydert
Company: OPTRON
Industry: GIS Solutions

The Lean Analytics Meetups are opportunities for thought-provoking discussions on very relevant topics. I enjoy attending as each meetup brings together an interesting combination of backgrounds, skills, and personalities that make each topic and discussion unique. It is a great way to start off a morning.

Quintin van Heerden
Company: CSIR, Built Environment
Industry: Spatial Planning

I have only attended one Meetup. Firstly, I was curious to experience how this works and secondly I posed a question on OR/MS education for which I required some insight. The experience was a pleasant surprise in the sense that there were some seven of us, huddled in the corner of a busy coffee shop and the topic I raised was discussed at length and in detail, where everyone contributed. I met new people, got worthwhile inputs to my question and spent a great early morning in the presence of wonderful OR colleagues! This will definitely not be my last Meetup.

Hans Ittmann
Retired, but still active and remaining passionate about OR!

Lean Analytics Meetups (Johannesburg)

by David Clark (David.Clark@pivotsciences.com)

From the organisers:

The ORSSA Joburg Lean Analytics Meetup group was founded on 30 July 2014 and we have held 66 events, mostly in the Rosebank area. So far this year we have had eleven, of which four, in March, took place at the Discovery Head Office in Sandton.

Without exception each event has been well worth the hour and half that we meet. Not only are there a broad range of participants, from those with years of experience in industry or academia, to students, to the merely curious, but the discussions have always been energising. They are an opportunity to lift your head from the specifics of the work you do and hear new perspectives, debate ongoing differences, explain and educate, and, in turn be taught new insights or views from people with shared interests.

All events like this owe much of their existence to core members who regularly attend, and we are fortunate to have members who bring a wealth of experience and knowledge. My thanks to them, as they have played a big part in the meetups success, and to all who have joined us to chat about things big and small.

- David

Summary of some of the topics discussed in 2017 so far:

- Trust networks, their future and evolution
- Machine learning – what is it?
- The TPOT library for ML pipelines in Python
- Ubers sharing of route data with trusted partners
- Highlights from CES 2017
- D-Wave and quadratic optimization
- CSIR to create a geomap of taxi routes
- Species classification with photography
- Leaning to build machines that think like humans
- Simpson's paradox
- LP Duality
- Alt-Facts
- The Mercator projection
- How much overlap is there between Data Science (and big data) and OR
- What is the future of transportation of people?
- Data Science / Big Data trends in 2017
- Domain clustering – Two cool ideas that extend well
- Steps towards AI – 1961
- Non-obvious ethical issues regarding working with people's data
- The first five jobs robots will replace
- When will Data science and Big data stop being buzzwords?
- What do extremely small probabilities mean?
- Interviewing Data professionals
- Technology causing trust issues in families
- Robotic lawyers
- Theory of Reason – Is the idea of system 1 and system 2 thinking wrong?
- AI and Robotics killing human work
- Clustering with domain knowledge – Why bother and who cares?
- Interesting ways to visualize process flows
- When to say No to data visualization
- P.E.S.T.L (E) analysis – A tool for strategic thinking applied to OR activities
- Roborace – Driverless electric car racing
- AI and the end of nationalism
- Bradford's law
- Driverless Cars and 2nd order consequences
- Integrating new approaches into existing methodologies and outdated models
- Ethically Aligned Design: How can we ensure AI/AS do not infringe human rights?
- How to drive ML adoption
- Changes to be made at schools to increase the pool of SA analytics professionals
- Ethically Aligned Design: How can we assure that AI/AS are accountable?
- Crowd counting
- TRIGGR – Analytics for mental health
- How to lie with big data
- Rethinking AI
- Ethically Aligned Design: How can we ensure AI/AS are transparent?
- Human Rights in the digital era
- Topics for conference talks
- Ethically Aligned Design: How can we extend the benefits and minimize the risks of AI/AS technology being misused?
- Five Levels of Analytics Maturity
- Learning from AI
- OR in genetics
- Golem Project
- What are we going to be doing work-wise in 10 years' time?
- Will AI systems develop emotions, and if so, so what?
- Ethically Aligned Design: Embedding values and norms into AI/AS systems

PF

I enjoy attending out Lean Analytics events as it keeps me in touch with developments in OR and allied fields and allows me to think and debate new problems. Discussions with like-minded colleagues in a relaxed environment can give fresh insights into problems and issues.

Paul Fatti
WITS, School of Statistics & Acturial Science

It keeps me abreast of the latest developments in OR and analytics. It's group of stimulating people, the conversation is never anything but sharp, intelligent and entertaining, and the coffee's good - what more could you ask for?

Dave Evans
Past president of ORSSA

DE

JR

The meetup gives me opportunities to discuss interesting questions that have come up in work and research with knowledgeable, diverse, humble people, in conversations which are absoloutely absorbing. The topics we discuss are fascinating and a fantastic introduction to new ideas and areas in analytics.

Jess Rees
Discovery Limited, Data Scientist

Attending the meetups means I get to hear about trending items in the OR and data science space without too much reading.

Angela Rademeyer
Discovery Limited, Divisional Manager

AR

DC

Great way to meet and engage with people with similar interests and problems. The conversations, opinions and debates really keep you thinking. They are great motivation to keep learning and exploring many disciplines that can both make use of, as well as inform, the field of operations research and analytics.

David Clark
OPSI Systems, Director of Operations

BOOK REVIEW: MULTIOBJECTIVE LINEAR & INTEGER PROGRAMMING

Written by Hans W. Ittmann (hittmann01@gmail.com)

Hans Ittmann

In 2014, the *Association of European Operational Research Societies* (EURO) introduced the EURO Advanced Tutorials on Operational Research initiative. This entails the publication of a series of textbooks, each covering an advanced topic in Operations Research. Mainly serving young researchers, these tutorials are also of value to senior researchers and practitioners who want to gain an insight and understanding of the specific topic. To date, three textbooks have been published with *Multiobjective Linear and Integer Programming* being the third book in the series.

Multiobjective optimization is a very active research area and fast evolving with continuous new developments. A number of recent books covering the topic, *e.g.* Luc (2016) and Antunes *et al.* (2016), have been published, each one following a different approach and emphasizing different aspects.

As opposed to classical single-objective function problems, *multiobjective problems* (MOPs) typically have multiple conflicting objectives. Thus, improving one objective will impact the value of others, leading to a trade-off between solutions. The main aim of multiobjective programming is to assist in obtaining a preferred solution amongst all the trade-offs. Solution methods can involve the *decision maker* (DM) directly using interactive methods or approaches where non-interactive exact methods can be used. The tutorial covers linear (MOLP), integer (MOIP), and mixed integer (MOMIP) MOPs with solutions that are respective-

ly continuous, discrete, and both continuous and discrete. Real-world problems tackled using MOPS include those in the fields of engineering, mining and finance.

The introduction of the book gives a historical overview of the development of optimization approaches. At the realization for the need to formulate and solve problems with multiple conflicting objectives, a new branch of mathematical programming, namely multiobjective programming emerged. Two distinct approaches towards addressing these problems were developed: (i) methods for decision support with multiple attributes; and (ii) methods of decision support with multiple objectives. The first refers to selection, ranking or categorization methods dealing with a finite set of alternatives while the second is concerned with problems where the alternatives are implicitly defined by a set of constraints. This tutorial is devoted to the latter approach.

MOP methods are classified according to the process used for aggregating the DM's preferences into three categories. With the aim of determining the best compromise solution, the methods are: (i) *a priori* aggregation of preferences; (ii) interactive, where the DM progressively articulates preferences; and (iii) generating, where there is no articulation of preferences. Aspects concerning all these approaches are discussed, including the process followed to arrive at an acceptable solution.

In Chapter 2, definitions, formulations and fundamental concepts of MOPs (linear problems, integer problems, mixed integer problems and non-linear problems) are presented in detail. These are richly illustrated with, for example, two dimensional graphic representations to demonstrate these concepts. Included are concepts such as efficient and nondominated solutions; weak and proper efficient/nondominated solutions; supported and unsupported efficient/nondominated solutions; the ideal solution as well as pay-off tables. At the end of the chapter, as in all chapters, a number of problem exercises are provided for further training.

Scalarizing techniques and surrogate scalar functions, the most common procedures to compute efficient/nondominated solutions in MOPs, are the focus of Chapter 3. Three techniques are discussed, namely: (i) selecting one of the objective functions to be optimized and treating the other objective functions as constraints (the e-constraint technique); (ii) optimizing a weighted-sum of the objective functions through assigning weighting coefficients to
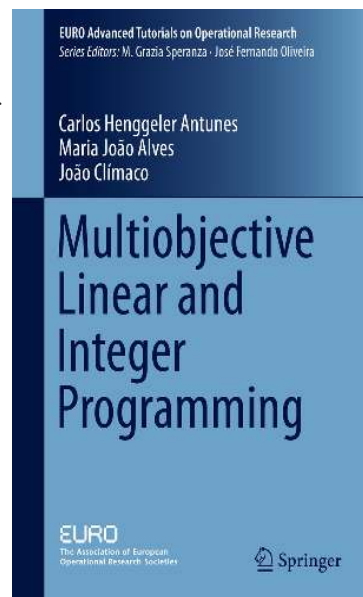
them (the weighted-sum technique); and (iii) minimizing a distance or achievement function to a reference point, such as the ideal solution, where the components represent aspiration levels that the DM would like to attain for each objective function (reference point techniques). As in Chapter 2 these are outlined in detail by describing the theory, showing different formulations, illustrating the solutions and associated concepts, through two-dimensional graphic representations.

Chapter 3 also deals with classification methods to compute nondominated solutions. Different classifications have been proposed based on aspects such as the degree of intervention of the DM, how the preferences of the DM are modelled, and others. The role of preference information is discussed as well. Brief mention is made of the lexicographic method (ranking objective functions according to the DM's preferences), goal programming (minimizing deviations from targets established by the DM) and the multiobjective simplex method for MOLPs.

Five multiobjective interactive methods for MOLP problems are described and illustrated in Chapter 4. These methods are STEM (Step Method), the Zionts and Wallenius method, TRIMAP, *Interval Criterion Weights* (ICWs) and Pareto Race. TRIMAP provides a more interactive computational environment than the formal method. It was developed specifically as a teaching tool. The methods included in this chapter differ mainly on the search strategies used.

An illustrative "guided tour" of an interactive software package iMOLPe (interactive MOLP explorer) is presented in Chapter 5. This package was developed by the authors mainly for teaching and decision support purposes. Features, among others, include: (i) scalarizing techniques (as outlined in Chapter 2); (ii) allowing for different search strategies and visualization of results; (iii) interactive versions of the STEM, Pareto Race and ICW methods. A step-by-step guided tour of four different examples is included, making full use of, and presenting, screen shots of outputs from the package. The iMOLPe package is a useful teaching tool, user-friendly and can handle problems with four or more objectives although the graphical representation for the objective space and the weight space are only available for problems with up to three objectives.

The last chapter is devoted to multiobjective integer and mixed integer linear programming problems. These problems offer different challenges, although similarities with what is presented in the earlier chapters can be found. Dif-

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Multiobjective Linear and Integer Programming

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ferent methods are discussed, namely: (i) generating methods and scalarizing processes; (ii) interactive methods; and (iii) an interactive reference point method using branch-and-bound: performing directional searches in MOMILP. Again, ample use is made of examples with the associated graphical representation of results. An adapted software package to deal with MOMILPs is discussed briefly. Both this package and the iMOLPe are supplied with the book.

This tutorial on multiobjective programming is based on the vast teaching and research experience of the authors. Concepts and methods are explained without any theorems or proofs. Readers do not require an advanced mathematics background to grasp the whole content of the book. It is clearly written, accompanied with exercises at the end of each chapter, making it a great contribution to acquiring knowledge in the field of multiobjective optimization.

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Multiobjective Linear and Integer Programming by Carlos Henggeler Antunes, Maria João Alves, João Clímaco, 2016, Springer-Verlag, Berlin, pp. 209, ISBN: 978-3-319-28744-7, EURO 76.99 (Hardcover).
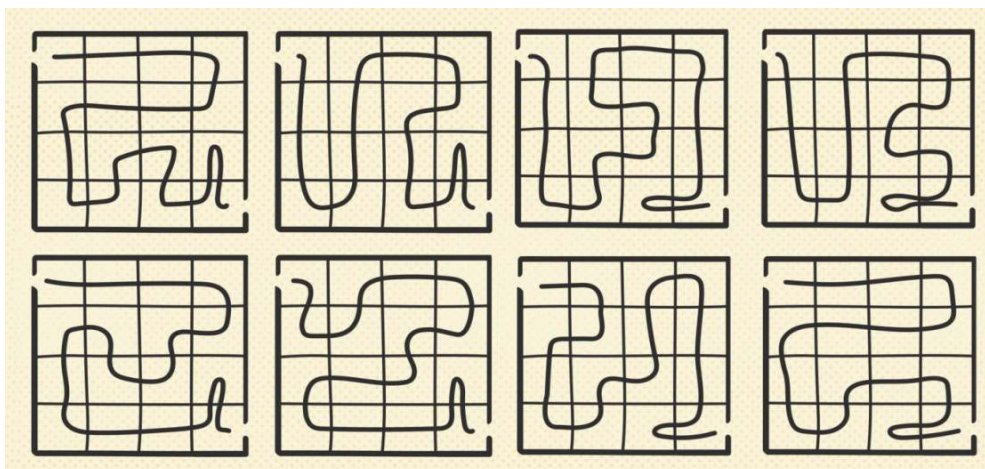
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PUZZLE SOLUTION

The key to this riddle is realising that you are not required to pull the emergency switch in the first room, the entrance, since it is not contaminated (by rule 3). You may leave this room, return and then proceed through the other door. And indeed, this is exactly what is required in order to visit all 16 rooms and end in the exit room. Once this is known, there are eight possible solutions to this problem:

This problem is related to Hamiltonian paths in graph theory, which are paths through a graph that touch each vertex in the graph exactly once. In the virus-contaminated lab, you cannot achieve a true Hamiltonian path and visit each room just once. For any even-sided grid configuration, a Hamiltonian path that starts and ends in opposite corners is not possible. But, because the first room is clear, you can backtrack through it to get back on the right track and pull the emergency switch in every room, saving the world from agonizing death by the prehistoric virus.