ORSSA

52nd **ANNUAL CONFERENCE OF THE OPERATIONS RESEARCH SOCIETY OF SOUTH AFRICA**

10-13 September **2023**

Pecan Manor Conference and Function Venue

Hartbeespoort, South Africa

Welcome from the Society President

Dear ORSSA delegates, welcome to the 52nd Annual Conference of the Operations Research Society of South Africa (ORSSA). Following on from a fantastic conference in Cape Town last year, we are back in Gauteng at the scenic venue of Pecan Manor in Hartbeespoort after 8 years. Much has changed in the world since then, and many of them in the fields which OR contributes to.

We are excited to have the Department of Decision Sciences at UNISA organise this year's conference under the leadership of Prof Philip Mashele. A special thanks, as always, goes to all the LOC members who have made this year's conference possible, as well as to the many people who have helped assist, judge, and review papers. Thank you for your time, commitment and support.

A warm welcome to our three fantastic keynote speakers: Professor Anna Bershteyn, Assistant Professor of Population Health at the NYU Grossman School of Medicine and Professor Ramasamy Sivasamy, Professor of Statistics at the University of Botswana. We look forward to your keynote presentations and are honoured to have your insight into the fields you work in.

The LOC chose the theme Evolutionary OR techniques: Hybrid with Machine Learning, which seems particularly apt in a period of renewed interest in the power shown by large language models. There can be no doubt that interest in AI is at an all time high, not only in academic fields, but in the public discourse as well. This spotlight on prescriptive systems provides tremendous opportunities for the OR community to find new and novel uses for these tools in our own problem domains and contribute to the growing debate of what constitutes good decision making, be that human, machine or a combination of both. The world today is in need of a high-quality, robust, decision-making systems as the challenges we face continue to test our understanding of the complexity and consequences of the actions we take

Thank you to all our sponsors for your valued and generous support: SACNASP, NWU Centre for Business Mathematics and Informatics, SU Logistics, SU Industrial Engineering, UCT Statistical Sciences, Elytica, Sharp, Bluestallion Technologies and Unisa Decision Sciences. South Africa faces many challenges as our country continues to grow and navigate its way through many local and international issues. We greatly appreciate the continued support that the Society has received during this time from both the academic and industry communities.

Thank you to Elytica for hosting another tutorial session and competition and to our many speakers from a wide range of disciplines, industries, and departments; thanks for sharing your work and experiences with us. My thanks go out to all of you. May good memories, inspiring conversations, renewed acquaintances, and new collaborations result over the next few days.

All the best for an exciting conference, which I now declare open.

David Clark, President
Operations Research Society of South Africa

Welcome from the Chair of the Organising Committee

Greetings, everyone! My name is Hopolang Phillip Mashele and I am the Chair of the Local Organising Committee. On behalf of the Local Organising Committee of the 52nd Annual ORSSA Conference, I would like to extend a very warm welcome to all of you. A special welcome to our keynote speakers Professor Sivasamy from University of Botswana; and Professor Bershteyn from New York University.

Let me send my sincere appreciation to the ORSSA Executive Committee for providing University of South Africa the opportunity to host the 2023 ORSSA conference and for its support to the Local Organising Committee during the organising process. My gratitude to all the members of the Local Organising Committee, who sometimes had sleepless nights to ensure that UNISA hosts a successful conference. To our head of research, Prof Marcia Mkansi, for accepting and honouring the invitation to open the conference officially, thank you so much!

ORSSA is the national and professional body tasked with furthering the interests of those engaged in, or interested in, Operations Research activities. This year's conference is hosted by the Department of Decision Sciences, which is a multidisciplinary department in the School of Economic and Financial Sciences of the College of Economic and Management Sciences at the University of South Africa. The theme of the conference is Evolutionary OR techniques: Hybrid with Machine Learning.

For the next three days we will be listening to experts and students who will be sharing with us their ideas and contributions they made in Operations Research and its related research areas. Let us engage with them during and after their presentations with the common objective of expanding knowledge and research outputs in Operations Research. I am personally looking forward to learning from my fellow researchers. I wish all of you a valuable and wonderful time! Thank you.

Phillip Mashele, Chair
ORSSA 2023 Local Organising Committee

Interested in making GOOD DECISIONS?

The department offers:

- BCom Honours Degree in Financial Modelling
- BSc Honours Degree in Operations Research
- Master of Commerce in Quantitative Management
- Master of Science in Operations Research
- Doctor of Philosophy in Operations Research

Admission requirements

Students should have a mathematical background equivalent to that of a typical undergraduate major in Operations Research, Financial Modelling, Mathematical, Physical or Engineering Sciences. The achievement should be above the 60% level for final-year modules in these fields.

Financial support

Top students have the opportunity to apply to the department as academic assistants while studying. The payment will cover a basic salary and tuition fees. The university's Student Funding Directorate (DSF) administers donor funds, in the form of study loans and bursaries, according to donors' criteria. The main aim is to assist financially needy and academically deserving students.

Contact

Department of Decision Sciences
PO Box 392, UNISA, South Africa, 0003
+27 12 433 4684 | qm@unisa.ac.za
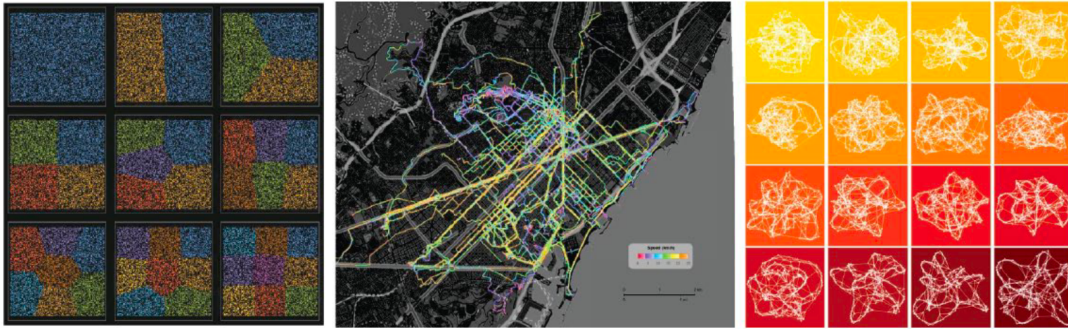**www.unisa.ac.za**

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— *The ORSSA 2023 Local Organising Committee* —

(1) Phillip Mashele, Chair (Department of Decision Sciences, University of South Africa)

(2) MT MaseTshaba (Department of Decision Sciences, University of South Africa)

(3) Eva van Deventer (Department of Decision Sciences, University of South Africa)

(4) Gomolemo Moagi (Department of Decision Sciences, University of South Africa)

(5) Mardi Jankowitz (Department of Decision Sciences, University of South Africa)

(6) Edinah Mudimu (Department of Decision Sciences, University of South Africa)

(7) Nolwazi Nkomo (Department of Decision Sciences, University of South Africa)

(8) Diteboho Lawrence Xaba (Department of Decision Sciences, University of South Africa)

(9) Sihle Ncube (Department of Decision Sciences, University of South Africa)

(10) Shivani Singh (Department of Decision Sciences, University of South Africa)

(11) Phumezile Kama (Department of Decision Sciences, University of South Africa)

(12) Erica Van Wyk (Department of Decision Sciences, University of South Africa)

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Pecan Manor Boutique Hotel Layout

— *Directions to conference Venue* —

Pecan Manor Boutique Hotel at (-25.766555, 27.767953)

Green Leaves Country Lodge at (-25.760937, 27.769170)

Sunday 10 September 2023

12:30–14:00	Lunch (Patio)
12:30–18:00	Onsite Registration (Patio, just outside the reception)
14:00–17:00	Conference Tutorial by Prof. Fanie Terblance (Silver Oak)
17:00–18:00	Executive Committee Meeting (Wild Teak)

Monday 11 September 2023

07:30–08:30	*Welcome Breakfast & Onsite Registration (Patio, just outside the reception)*
08:30–08:40	**Welcome by ORRSA President and LOC Chair (Silver Oak)**
08:40–09:10	**Opening remarks: Prof. Marcia Mkansi (CEMS Office of Graduate Studies) (Silver Oak)**
09:10–10:10	**Plenary Session A: Opening Keynote Address by Prof. Ramasamy Sivasamy (Silver Oak)**
10:10–10:30	*Tea/Coffee (Patio)*
10:30–12:30	I: Optimisation (Silver Oak)
12:30–13:30	*Lunch (Patio)*
13:30–15:00	II: OR in Energy (Silver Oak)
15:00–15:30	*Tea/Coffee (Patio)*
15:30–17:30	*Conference Social Outing*
19:00–22:00	*Social Mixer (Patio)*

Tuesday 12 September 2023

09:00–10:00	III: Decision Support
10:00–10:30	*Tea/Coffee (Patio)*
10:30–12:30	IV: National Student Competition ((Silver Oak)
12:30–13:30	*Lunch (Patio)*
13:30–15:00	V: OR in Education and Healthcare ((Silver Oak)
15:00–15:30	*Tea/Coffee (Patio)*
15:30–17:30	*ORSSA Annual General Meeting* (Silver Oak)
18:30–22:00	*Conference Banquet (Pecan Manor)*

Wednesday 13 September 2023

08:30–10:30	VI: Miscellaneous (Silver Oak)
10:30–11:00	*Tea/Coffee (Patio)*
11:00–11:50	**Towards a National Strategy for Mathematical Sciences (Silver Oak)**
11:50–12:50	**Plenary Session B: Closing Address by Prof. Anna Bershteyn** (Silver Oak)
12:50–13:00	*Final announcements, thank yous & good bye (Silver Oak)*
13:00–14:00	*Lunch (Patio)*

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  - Normal mode
  - Statistics mode with linear regression and summary page of all statistics
  - Table mode with 2 functions, unlimited coordinates and asymptotes
  - Complex numbers mode
  - Equation solving mode with minimum/ maximum value
  - Matrix mode with up to 4 x 4 matrices
  - Vector mode
  - Distribution mode with normal, binomial and poisson cumulative and probability distributions.
  - Drill mode

- 9 Memory keys
- Time calculations
- 44 Metric conversion rates
- 52 Constant values
- Short cut percentage function, and standard percentage function.
- 5 Number summary (quartiles, minimum and maximum, and median) in statistics mode
- Number base conversions (binary, hexadecimal etc)

Linear Regression summary page

Multiplicand function

Integration function

Up to 4 x 4 matrices

Distribution function calculations

Sunday 10 September 2023

Lunch (12:30–14:00)
[Patio]

On-site Registration (12:30–18:00)
[Patio, just outside the reception]

Conference Tutorial (14:00–17:00)
[Silver Oak]

Executive Committee Meeting (17:00–18:00)
[Wild Teak]

Monday 11 September 2023

On-site Registration (08:00–08:20)
[Patio, just outside the reception]

Monday 11 September 2023 (08:20–10:10)

Plenary Session A: Conference Opening
Chair: Robert Bennetto [*Venue:* Silver Oak]

08:20–08:30	**Phillip Mashele** (Chair, Local Organising Committee) *Welcome & announcements*
08:30–08:40	**David Clark** (ORSSA President) *Presidential address*
08:40–09:10	**Prof. Marcia Mkansi** (UNISA CEMS Office of Graduate Studies) *Conference opening address*
09:10–10:10	**Ramasamy Sivasamy** (Keynote Speaker) (p. 20)

Tea/Coffee (10:10–10:30)
[Patio]

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[Patio]

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[Patio]

Conference Social Outing (15:30–17:30)
Details to be provided during On-site Registration

Social mixer (19:00–22:00)
Sponsored by *ORSSA*
[Patio]

	Tuesday 12 September 2023 (09:00–10:00)

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	Tuesday 12 September 2023 (10:30–12:30)

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11:30–12:00	**Jacobus King**, *A new vehicle routing problem for increased driverroute familiarity* (p. 30)
12:00–12:30	**Bianca van Zyl**, *A generic framework for aspect-based sentiment analysis* (p. 31)

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[Patio]

Tuesday 12 September 2023 (13:30–15:00)

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[Patio]

ORSSA Annual General Meeting (15:30–17:30)
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Gala banquet (18:30–22:00)
[Pecan Manor]

Wednesday 13 September 2023

Wednesday 13 September 2023 (08:30–10:30)

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[Patio]

Wednesday 13 September 2023 (11:00–13:00)

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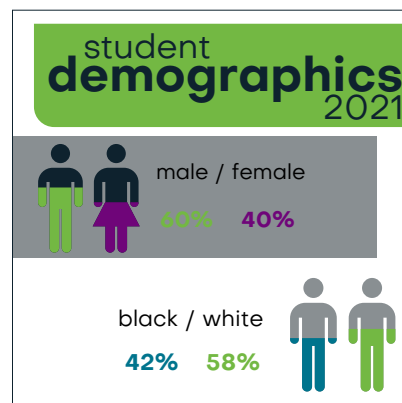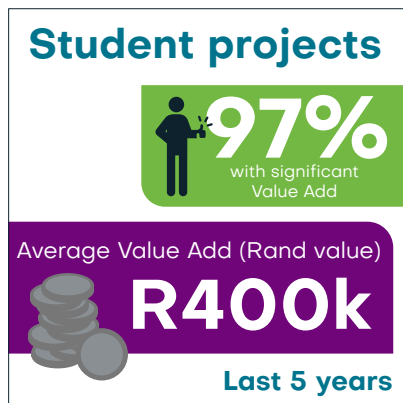|	
11:00–11:50	**Zurab Janelidze (President of SAMS) and Inger Fabris Rotelli (President of SASA)**
	Towards a National Strategy for Mathematical Sciences
11:50-12:50	**Anna Bershteyn** (Keynote Speaker)
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12:50–13:00	**David Clark** (ORSSA President)
	Final announcements, thank yous & good bye

Lunch (12:30–13:30)
[Patio]

The Centre for Business Mathematics and Informatics (BMI) was founded in 1998 as a joint initiative between the North-West University (then Potchefstroom University) and Absa. BMI's vision was to become a centre of excellence in risk management and the mission was to conduct professional training and research in financial risk.

BMI@NWU has established:

- a **well-recognised brand** in the financial services industry for delivering excellent skills and research in risk management and data science;

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- **long-standing relationships** with clients, driven through a spectrum of industry directed research projects;

- **globally recognised** training programmes in quantitative risk management, actuarial science, data science and financial engineering;

- **collaboration agreements** with a number of universities, locally and abroad, in terms of training and research;

- international **accolades and awards** for risk and data science research;

- the banking industry's preferred **talent source** for risk and business analytics talent; and

- consistently high **client satisfaction** and recommendation levels.

94%
of industry projects with
positive ratings

Student projects

97%
with significant
Value Add

Average Value Add (Rand value)

R400k

Last 5 years

student demographics 2021

male / female
60% **40%**

black / white
42% **58%**

project requests outnumbers available students

research accolades

✦ Operational Risk: Paper of the Year 2016
✦ RGA Prize from the Actuarial Society of South Africa 2016
✦ Sichel medal for the best published research in 2015
✦ SAS Academic Intelligence Award 2005

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— *List of Sessions & Chairs* —

RESEARCH:

OPERATIONAL RESEARCH
This research group focuses on the development of decision modelling and support tools, including both "hard" (e.g. optimization and simulation) and "soft" (e.g. problem structuring and systems modelling) approaches, relevant to critical national decision and policy making.

DATA SCIENCE
Data science is an exciting new field that uses computer-intensive statistical methods to identify patterns and make predictions using large volumes of data. The applications of data science are diverse, ranging from predicting fraudulent transactions before they occur to extracting marketing insights from unstructured social media data.

BIOMEDICAL STATISTICS
This interdisciplinary group brings together researchers involved in the analysis of medical and biomedical data with a focus on advanced methodology applicable to bioinformatics, infectious disease modelling, longitudinal and time-to-event modelling, growth curve modelling, causal modelling, methods for incidence estimation and multivariate analysis.

STATISTICS IN ECOLOGY, ENVIRONMENT & CONSERVATION
The Centre for Statistics in Ecology, Environment and Conservation focuses on conservation, animal and plant demography, climate change, understanding of biodiversity patterns, evolutionary ecology and macroecology, with an overarching theme of structured decision support.

STATISTICAL FINANCE
This is a transdisciplinary research group working on the intersection of the statistical analysis in data-intensive finance and mathematical statistics that considers various data-informed approaches to both practical and theoretical problems in low and high-frequency finance.

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA · UNIVERSITEIT VAN KAAPSTAD

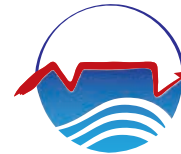# STATISTICAL SCIENCES

WHO WE ARE:

The Department of Statistical Sciences at the University of Cape Town is committed to the development of the statistical sciences within and beyond the university. In its teaching, the department recognises that there are needs both to train professionals in the statistical sciences, and to provide quantitative and decision-making skills to students in other disciplines. In its research, the department seeks to maintain a balance between the development of theory and applications of that theory with a focus on supporting policy and decision-making.

The Department of Statistical Sciences was established in 1965 as the Department of Mathematical Statistics under the headship of the late Professor Cas Troskie. It assumed its current name at the beginning of 1991 to reflect its broader teaching and research activities. Located in the south wing of the PD Hahn building, the department is situated at the heart of the beautiful UCT upper campus at the foot of Table Mountain.

DEPARTMENT OF STATISTICAL SCIENCES
CONTACT DETAILS: Tel: +27 (0)21 650 3219
www.facebook.com/statistics.uct
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DEPARTMENT OF STATISTICAL SCIENCES
PHYSICAL ADDRESS: PD Hahn Building (South Entrance)
Level 5 below the Science Faculty Office, Upper Campus, UCT

CONTACT DETAILS: Tel: +27 (0)21 650 3219 Fax: +27 (0)21 650 4773
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— *List of Paper Titles*‡ —

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1. Capture models using LaTeX

```
bin x, forall n in N;
bin y, forall c in C, forall n in N;

max sum_{i in N}{ v_{i}*x_{i} };

constr x_{i} <= 0, forall i in E;
constr x_{i} <= x_{j}, forall i in L, forall j in A(i);
constr x_{i} >= sum_{j in J(i)}{ x_{j} } - 3, forall i in NH;
constr x_{i} <= x_{j}, forall i in I, forall j in B(i);
constr sigma_{0}*x_{i} <= sum_{j in D(i)}{ x_{j} }, forall i in S;
```

4. Select solvers for collaborative optimization

- ☑ Greedy Heuristic
- ☑ Gurobi - strong branching
- ☐ COIN-OR Cbc
- ☐ Constraint Programming Solver
- ☑ HiGHS MIP Solver
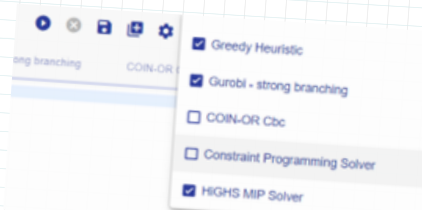
2. Simulate/Predict using Python

```
import elytica
import simpy
import numpy
import math
import pandas as pd
import networkit as nk

SIMULATION_RUN_HOURS=100
network_nodes = json.loads((pd.read_excel("simulation
node_xyz = {i["id"]:[ float(i["x"]), float(i["y"]), f
network_arcs = json.loads((pd.read_excel("simulation.
arc_distances = { i["from_id"]: { i["to_id"]: float(j
trucks = json.loads((pd.read_excel("simulation.xlsx",
truck_type_info = json.loads((pd.read_excel("simulati
truck_type_efficiency = json.loads((pd.read_excel("si
truck_type = {i["id"]: i["type_id"] for i in trucks}
```

5. Graph & export results
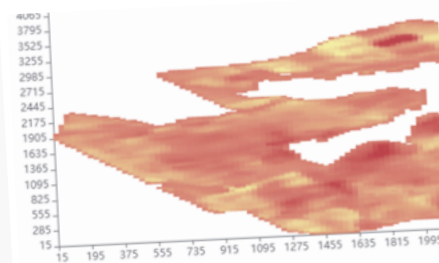
3. Inspect models visually

$$\text{Maximize } \sum_{i \in N} v_i x_i \qquad\qquad : 25$$
$$x_i \leq 0, \qquad \forall i \in E \qquad\qquad : 27$$
$$x_i \leq x_{j_i} \qquad \forall i \in L, j \in A(i) \qquad : 28$$
$$x_i \geq \sum_{j \in J(i)} x_j - 3, \qquad \forall i \in NH \qquad : 29$$
$$x_i \leq x_{j_i} \qquad \forall i \in I, j \in B(i) \qquad : 30$$
$$\sigma_0 x_i \leq \sum_{j \in D(i)} x_{j_i} \qquad \forall i \in S \qquad : 31$$

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— *List of Authors* —

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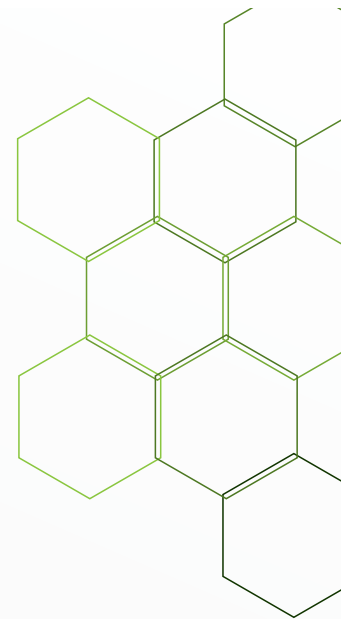
01 | LEGAL COMPLIANCE NSP ACT (27 of 2003)

02 | RECOGNITION AS A PROFESSIONAL

03 | PUBLIC CONFIDENCE IN YOU AS A SCIENTIST

04 | MARKETABILITY (EMPLOYERS REQUIRE REGISTRATION)

05 | CODE OF CONDUCT – TRUST FOR ETHICAL VALUES

06 | INPUT TO GOVERNMENT – SACNASP VOICING SCIENTISTS' INPUT AT MINISTERIAL LEVEL

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— *Plenary Paper Abstracts* —

Opening Plenary Speaker: *Ramasamy Sivasamy*

Machine learning classifiers for diagnosis and prediction of benign and malignant tumors using Python

Breast cancer occurs when normal cells begin to change and grow into a non-cancerous (meaning benign) tumor or a cancerous tumor (meaning malignant). Low-precision diagnostic methods such as radiography or mammography can misclassify results as false positives or false negatives, which is dangerous for human patients. Sufficient information on genomic profiles, tumor histopathology, radiological images, proteomic analysis, etc. are necessary to create a cancer model to distinguish between benign and malignant tumors. Thus, methods based on Fisher's linear discriminant function (FLDF) or linear discriminant analysis (LDA), principal component analysis (PCA), and neural network (NN) models and other classifiers of Python can be used to minimize false positives. We provide one of the best hybrid models that can accurately predict breast disease status. The proposed model is used to analyze data already observed in cancer studies of benign and malignant tumors. Our methods help hospitals improve individualized treatment and precision medicine for each patient. We also provide recommendations to advance the diagnostic stage and increase the current challenges of developing accurate predictions as a multidisciplinary effort.

Biography of the speaker:

Ramasamy Sivasamy is currently a Professor of Statistics at the University of Botswana, where he has been teaching and conducting research since 2008. Prof. Sivasamy received his Ph.D. in Statistics from Annamalai University, Annamalai Nagar, India, and has held academic positions at several institutions, including Annamalai University. His research focuses on stochastic processes and their applications relevant to industrial engineering and operations research. Specific topics include discrete and continuous time Markov chains, the Poisson process and its variants, renewal and Markov-renewal theory, regenerative and Markov-regenerative processes, Brownian motion and martingales. Prof. Sivasamy is a life member of the International Biometric Society (IBS), the Indian Science Congress Association, and the Indian Society for Probability and Statistics.

Closing Plenary Speaker: *Anna Bershteyn*

Informing effective and equitable healthcare policy with mathematical modeling: insights from real-time modeling during the COVID-19 pandemic.

Mathematical modeling is a useful tool for comparing the projected impact of healthcare policy options. When applied in collaboration with local health authorities or normative agencies, it can help to inform policy decision-making under realistic constraints and values. In particular, decision-makers often value both the amount of health that a health system can deliver under constraints, and the extent to which policies reduce health disparities. This keynote will explore methods for estimating equality-adjusted health outcomes of policy scenarios using mathematical modeling. Dr. Bershteyn will describe prior work applying these methods to inform real-time policy decision-making regarding allocating a limited supply of COVID-19 vaccines in New York City. This motivating example illustrates the available methods and current challenges of supporting decision-making in the context trade-offs between efficiency and equity in health policy.

Biography of the speaker:

Anna Bershteyn is an Assistant Professor of Population Health at New York University Grossman School of Medicine. Her research focuses on mathematical modeling to inform healthcare policy decision-making, primarily around high-burden infectious diseases. She previously led the HIV and tuberculosis modeling team at the Institute for Disease Modeling, now part of the Bill and Melinda Gates Foundation in Seattle, Washington. She holds a PhD from the Massachusetts Institute of Technology, where she studied HIV vaccine discovery.

Tutorial session: *Unraveling Complexities: Harnessing Graph Theory and Optimization for Real-World Problem Solving*

Professor Fanie Terblance of Elytica

In an era where intricate systems and complex data structures are pervasive, bridging the gap between theoretical methods and practical problem-solving becomes crucial. Elytica cordially invites you to our tutorial session at the forthcoming Annual ORSSA conference. This tutorial is geared towards anyone interested in leveraging the potential of modern computational techniques to solve real-world prescriptive analytics problems.

The Elytica team of experts will delve into the crossroads of Mixed Integer Linear Programming (MILP) and graph theory, explaining how they are complementary in formulating and solving multifaceted optimization problems. We will place a particular emphasis on network design and flow optimization problems, commonly encountered in logistics, supply chain management, telecommunications, and transportation.

The tutorial will guide attendees through the nuances of formulating optimization problems using logical decision variables and graph theoretic principles, primarily focusing on flow conservation modelling. We will demonstrate how our cloud-based platform harnesses these methodologies, offering optimization, simulation, and predictive modelling as a service.

INDUSTRIAL ENGINEERING

OPERATIONS AND SUPPLY CHAIN MANAGEMENT

PROF JAN VAN VUUREN, DR STEPHAN NEL, PROF JAN HAVENGA AND DR ZANE SIMPSON

Digitilisation and Automation in Operations

The work life and the organisational world is changing very fast. Digitilisation and the fourth industrial revolution are accelerating these changes. A key research focus is on the digitalisation of operations and value chains in manufacturing and service environments. Digitilisation has touched all aspects of businesses, including supply chains and operating models/ business models. Today, new technologies have enabled organizations to transform their existing hybrid structures (combination of paper-based and IT-supported processes) into more flexible, open, agile and collaborative digital models. Digital value chains enable business process automation, organizational flexibility and digital management of corporate assets.
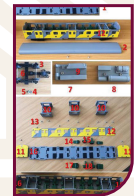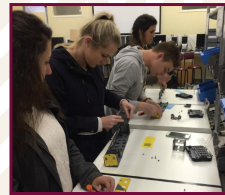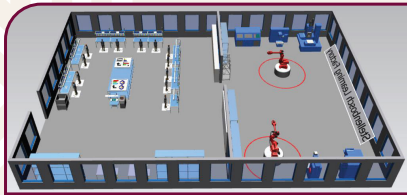
Macrologistics Management and their impacts

Macrologistics is the scoping and prioritizing of national policy, projects and macrologistics performance measurement. Macrologistics involves a complex group of interrelated economic, infrastructure and organizational systems that could be analyzed and improved using a systems engineering approach. This has been done to some extent within the Logistics Management domain through modelling sub-systems and research in micrologistics, but a vast number of research opportunities exist from the systems engineering perspective. This opportunity spans across engineering disciplines with applications on both detail level but also at strategic or even national level. These include but are not limited to the supply chain in general, logistics, systems modelling, operational research, financing and costing, infrastructure development, equipment design and policy environments with large scale benefits for a South Africa in need of growth and development.

Macrologistics improvement is possible through a multidisciplinary hierarchical system, i.e. on the first level by avoiding unnecessary inputs (macroeconomics), on the second level by avoiding unnecessary activity (industrial engineering and logistics) and on the third level by improving the efficiency of infrastructure (civil engineering) and equipment (mechanical engineering) used in logistics.

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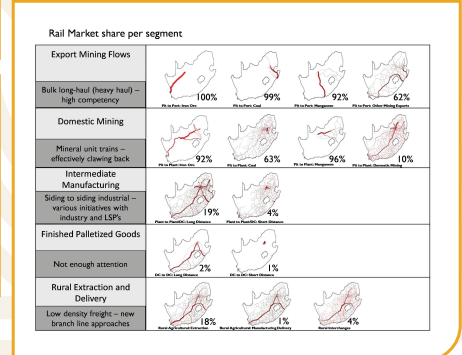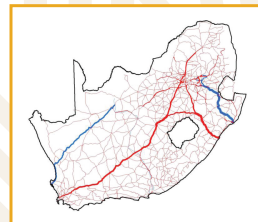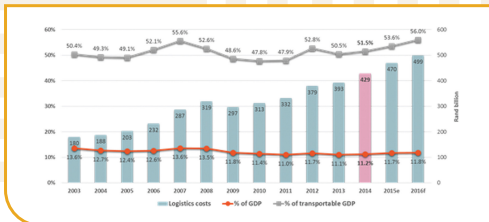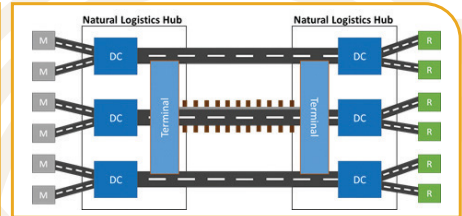
— *Contributed Paper Abstracts* —

Session I: Optimisation

A multi-objective optimisation approach to the generalised bin packing problem

Funanani Netshitungulu *, Rosephine Georgina Rakotonirainy*
University of Cape Towm

The generalized bin packing problem consists of loading a set of profitable non-compulsory and compulsory items into bins so the total cost, given by the difference between the total cost of the selected bins and the total profit of the loaded items, is a minimum. Such problem is mainly encountered in the transportation industry which has grown massively over the years. In this work, the problem is modelled as a multi-objective problem with respect to two conflicting design objectives involving minimization of the cost of bins used and maximization of the profits of packed items. A multi-objective evolutionary algorithm is developed to solve the problem. The multiobjective framework as well as the preliminary results obtained will be presented. Future research direction will also be discussed.

Keywords:bin packing problem, multi-objective optimisation, evolutionary algorithm. **Status**: Work in progress

Biography of the speaker:

I am a UCT Masters student, doing my MSc in Operations research. I completed my B.Bus.Sc in Analytics in 2022, And as part of my Honours project, I submitted a thesis on 'Heuristics for the Generalized Bin Packing Problem'. I might have liked the challenge a bit too much as I am now continuing with the same topic, just from a different angle with different methods.

Optimizing the 2023 Formula 1 calendar to reduce distance travelled by cargo sets

Michaela Jayne Budge, Jeanette Thiart*
Stellenbosch University

This research focuses on optimizing the distance that cargo is shipped in Formula 1 (F1) by rearranging the current schedule of twenty-three races. By reducing the total distance between venues, there will be a related reduction in travel time and cost. Logistics has become a crucial aspect of the sport due to the extended race schedule implemented to please a growing global fan base. There is a dire need to minimize the total distance travelled between circuits and across time zones to make the sport more sustainable. This research addresses this challenge by implementing an Integer linear programming formulation (ILP) of the multiple salesman problem (mTSP) to minimize the total distance cargo is transported. Both the critical cargo, that follow the main calendar schedule, and the noncritical cargo, of which there are multiple sets, are considered for races in the European - Middle East (EME) region and further flyaway races. The results show that a significant reduction is possible by rearranging the F1 calendar.

Keywords: Routing problems, Travelling salesman, Integer programming, Sustainability. **Status**: Complete results

Biography of the speaker:

I am an honours student at Stellenbosch University and am loving Maties student life. Being exposed to such an interesting variety of subjects in my degree has been a very exciting challenge, and I am absolutely fascinated by what I learnt during my undergraduate degree, specifically in my two favourite subjects: Business Analytics and Operations Research. Seeing how data is used in the corporate world to make decisions is intriguing, and I seem

to have found my niche in the world of Operations Research. I live in Stellenbosch and I enjoy running in nature, being a tourist in my own city, and finding hidden gems of places to eat and things to do.

Don't Crash, Just Hash

Zachary David Bowditch*
Icepack

Optimisation algorithms are often laden by the challenge of searching large combinatorial spaces in manners both efficient and effective. This motivates the design of mechanisms that mitigate against searching the same solution subspace more than once, in algorithms involving stochastic methods, and that avoid cycles in the search. This talk will look at using suitable hash functions, with analysis of their efficacy, as a means of tracking and looking up previously calculated solution candidates in clustering algorithms, with the aim of improving space and time complexity, and avoiding duplicate search trajectories.

Keywords: Hashing, Clustering, Metaheuristics **Status**: Work in progress

Biography of the speaker:
Zach's academic background is in mathematics and computer science, and has pursued postgraduate research in mathematical logic. He joined Icepack at the end of 2022, where he has learned to appreciate much more the worlds of operations research, software design and mathematical optimisation, tackling problems in the area of logistics.

A hybrid memetic algorithm optimisation approach for capacitated vehicle routing with time constraints.

Jared Meyer Tavares *, *Rosephine Rakotonirainy*
University of Cape Town

This paper presents a hybrid heuristic approach for the Capacitated Vehicle Routing Problem with Time Windows (CVRPTW), where a homogenous vehicle fleet is subject to stringent time constraints. The proposed Hybrid Memetic Algorithm Optimisation (HMAO) integrates an innovative heuristic algorithm for initial solution generation. We use the established Solomon instances as benchmarks to evaluate our algorithm's performance. The experimental results indicate that our hybrid approach effectively addresses the CVRPTW problem within a relatively short time period. Additionally, this algorithm has potential practical applications for vehicle routing scenarios requiring near-optimal solutions and strict adherence to time constraints.

Keywords: vehicle routing, memetic algorithm, time windows, hybrid **Status**: Work in progress

Biography of the speaker:
I'm Jared Tavares. Over the years, I've found my path in the fascinating landscape of disruptive technology. With a focus on continuous learning and contribution, my work revolves around data analysis, project management, and marketing. I also find great interest in developing machine learning models, web and app development, and have dedicated time to understanding the complexities of cloud architecture. In my career, I've had the good fortune to lead a few interesting projects. Among these was the 'Study Hard Study Smart', an online platform aimed at bridging the educational gap for disadvantaged students. Another was '2Jump', a mobile game that garnered encouraging appreciation on both the Google Play Store and Apple App Store shortly after its launch. I had the enriching opportunity to serve as an independent contractor for the Clinton Health Access Initiative (CHAI) in collaboration with the Modelling and Simulation Hub, Africa (MASHA). There, I was involved in developing a Bayesian calibration algorithm for a DTP model and I am currently working on a solution for transport-related

issues in the Eastern Cape. Presently, I'm engaged as a Research Officer in the Statistical Consulting Division at the University of Cape Town. This role has accentuated the value of collaboration and given me a platform to assist clients from various backgrounds with their research. Throughout this journey, I've earned the titles of a Google Cloud Architect and AWS Cloud Practitioner. These certifications, while significant, are just tools for me to contribute better to projects and initiatives that matter. As I continue along this path, I remain open to new opportunities and exciting projects, particularly those that have the potential to create a positive impact. I look forward to the possibility of learning from and contributing to your endeavours.

Session II: OR in Energy

The tale of two grids. A sunny forecast for OR.

Robert Bennetto [*]
Icepack

The tale of two grids. A sunny forecast for OR. Presentation abstract: This talk is a two-part session on a personal project to migrate the estate/complex I live in to (mostly) off grid. There are several interesting aspects to the problem which include: • the costbenefit analysis of how much solar to acquire, • the benefits of aggregated demand, • different architectures for implementation, • financing models that are available, • how to create a revenue stream for the project, • how to write off the tax, • driving individual user behavior, • using real-time data to action near-optimal decisions • as well as mitigate against system failure and hard-constraints that exist in the real world. This is one of those topics which is either poorly understood or poorly explained (or both) by many in the space as a result of how many different aspects it touches. We've created a new type of design-template for a installation which does not cost residents anything more than what Eskom currently charges, making it a financially frictionless decision. The system yields 90current power needs without a reduction in our consumption. The solution is achieved by leaning heavily into IoT devices, gathering data, and implementing smart decisions which curtail load dynamically within our network, protect our equipment and literally keep the lights on. **Keywords**:Renewables, Solar, IoT, OR in Business **Status**:Complete results

Biography of the speaker:
Rob is a founding member of the Order-of-the-computational-complexity - a religious belief that each wasted computational cycle needs to be repaid in the afterlife, by hand. As such, he spends most of his days concerned with polynomial time approximations and efficient implementations so that he can have a happy afterlife.

A network approach to trending topics on Twitter

Emma Davis * Kurt Marais
Stellenbosch University

A trending topic on Twitter may take on the form of a word, hashtag, phrase, topic of discussion or even just a name and becomes popular amongst many social media users. A topic of this nature receives a sharp increase in popularity for a finite amount of time. A network approach is used to investigate trending topics that exist on Twitter. The social networks constructed in this study are comprised of nodes which represent Twitter users and edges exist between two users when one user mentions another user in their tweet, also referred to as a reply network. Networks are constructed and analysed from datasets comprised of tweets relating to trending topics in technology, entertainment, and healthcare. These networks are analysed on a node-level and on a graph-level using network analysis techniques and are compared with one another to determine whether a trending topic has a significant network structure. Influential nodes are also identified. All of the networks were found to be sparse networks. Key users were identified and had larger centrality measure values compared to other nodes in the network. The most influential nodes in the network relating to technology and healthcare were significantly more influential than the other nodes in the network, and these two networks comprised of at least 50component compared with the entertainment network. It was also determined that the average path length of the networks increased when the order of a network was greater, and that a lower network transitivity led to a longer average path length. The average path lengths were found to represent lengths similar to the theorised degree of separation, thus indicating that social networks surrounding trending topics on Twitter reflects that of offline social networks.

Keywords:Social network analysis, Twitter, trending, social media **Status**:Work in progress

Biography of the speaker:

Emma Davis is a student from the Department of Logistics at Stellenbosch University currently completing her Honours in Operations Research. She is a BCom Mathematical Sciences graduate with a strong passion for mathematics, data, and statistics. Her research is focused on better understanding the network of users on Twitter that surround a trending topic and how these users interact with one another.

Large language Models: Basics and Debates

Jessica *
Discovery

In the rapidly evolving world of AI, Large Language Models (LLMs), have emerged as one of the most prominent advancements. This talk will give you the lowdown on how these massive and impressive models are trained with tons of data and some serious computing muscle. We'll cover their many uses, from content creation to matchmaking to customer service. But we all know that with great power comes great responsibility, so we'll also discuss some important ethical debates surrounding LLMs, including potential misuse, climate impact, and the question of whether they're even that smart and worth all the hype. Let's dive in for in interactive and engaging conversation!

Keywords: **Status**:

Biography of the speaker: Jess Rees is a computer scientist and operations researcher by training, a data scientist by profession, and an NLP nerd at heart. She currently heads a team of data scientists at Discovery

focusing on the creation and deployment of Natural Language Processing projects, including the research and development of Large Language Models. She has a Bachelor of Business Science in Analytics from UCT and a Master's in Data Science from UP. When not contemplating AI, Jess enjoys board gaming, admiring fairy lights, and asking people to tell their dogs she says hi.

A game theoretical study of the Sermon on the Mount

Esranel Becker *, Lieschen Venter
Department of Logistics, Stellenbosch University

A game theoretical study of the Sermon on the Mount Presentation abstract: How does one win in a game of life in community? The Sermon on the Mount can be seen as strategies according to Christian tenets. These strategies may appear counterintuitive strategies for victory. What is victory in the game of life and how do we quantify it? And can the strategies as set out in the Sermon lead to sustainable victory? Game theory provides a unique perspective as an analysis of the conflict between a human's selfish ego and the desire for social relationships. We quantify the game of the Sermon on the Mount for ego-depletion and prosocial gain, with five tasks identified and quantified accordingly. We view the Sermon as a set of strategies for achieving success in life, and calculate the Nash equilibrium to determine the best strategy for each player. We calculate the expected values for the five tasks by the Analytical Hierarchy Process (AHP), and simulate and rank repeated interactions between two players by their total expected payoff values as three types of repeated games, namely, natural, faith, and sustainability games. We show that living according to the tasks in the Sermon on the Mount does not occur intuitively, but with faith a player can profit from and be victorious in following these strategies. In scenarios where the opponent mirrors the player's strategies, the best outcome for both players is achieved when both players cooperate to reward their opponent.

Keywords:Game theory, behavioural economics, religious studies, quantification, decision analysis **Status**:Complete results

Biography of the speaker:

Esranel Becker hails from Namibia. She is currently enrolled to complete her MCom degree in Operations Research and she is a member of the Systems Thinking for Education Policy (STEP) research group at Stellenbosch University. Her research interests include finding innovative ways to quantify complex qualitative concepts and to transform these for mathematical modelling and optimisation.

A decision support tool for vehicle routing in the retail sector aimed at improving driver-route familiarity

Marlize H. de Villiers*, Jan H. van Vuuren, Jacobus C.P. King
Stellenbosch Unit for Operations Research in Engineering

A decision support tool for vehicle routing in the retail sector aimed at improving driver-route familiarity Presentation abstract: A typical activity in the supply chain of retail organisations that is not visible to the consumers, but essential for ensuring the availability of a variety of products at a competitive price, is called vehicle routing. This activity consists of planning the transportation of commodities from a distribution center, often also referred to as a depot, to stores using a fleet of delivery vehicles. An industry partner attached to this project, however, often encounters challenges when it comes to the practical implementation of planned delivery routes, which cannot be addressed efficiently by standard and commercially available routing software. Unfavourable traffic conditions, unanticipated road works, and drivers who travel on roads that are not suited for their delivery vehicles are some of the problems reported by the industry partner. These challenges often lead to an increase in travel times and a subsequent degradation in the operational efficiency with which deliveries are performed. A possible solution aimed at improving the practical implementation of planned delivery routes is to increase driver-route familiarity. The goal in this project is to design and implement computerised decision support aimed at providing highquality routing solutions for retail organisations, which attempts to improve the practical implementation of planned delivery routes by increasing driver-route familiarity (allowing drivers to travel to some extent along routes with which they

are familiar). In pursuit of this goal, a multi-attribute vehicle routing problem for increased driver-route familiarity is derived in the form of a mixed-integer programming problem. The model is concerned with computing a set of high-quality routing solutions with the objective of minimising transportation cost. The proposed model accounts for common operational constraints encountered by retail organisations, such as the limited capacity of delivery vehicles, time-windows specified by customers, the possibility of split deliveries, and a heterogenous fleet of delivery vehicles that are available to service customers. The model is implemented in IBM ILOG's CPLEX Optimisation Studio 20.1.0. The implementation of the model is verified and validated to ensure the reliability and credibility of the model. The model and its implementation is embedded within a user-friendly decision support tool and applied to a case study involving real-world data supplied by the industry partner so as to demonstrate its practical applicability.

Keywords: Combinatorial optimisation, Mixed-integer programming, Vehicle routing problem, Retail sector, Driver-route familiarity, Decision support tool **Status**: Complete results

Biography of the speaker:
Marlize's journey began in the picturesque town of Stellenbosch, where she attended Stellenbosch Primary and High School. Graduating as the top student in 2018 from Stellenbosch High, she set her sights on a BEng Industrial Engineering degree at Stellenbosch University. During her undergraduate studies, Marlize's fascination with mathematics and problem-solving led her to discover her passion for Operations Research (OR). Algorithms, mathematical programming, simulation, and machine learning became her areas of focus, and she excelled in these subjects. With determination and hard work, Marlize graduated with a Cum Laude degree, achieving the 3rd position in her class. Her exceptional abilities in optimisation were recognised when her final year project received the OPSISystems award for the best optimisation project. Driven by her love for OR, Marlize is now pursuing a Master's degree at Stellenbosch Unit for Operations Research in Engineering, where she continues to deepen her knowledge and expertise in the field.

A new vehicle routing problem for increased driverroute familiarity

Jacobus C.P. King*, Jan H. van Vuuren
Stellenbosch Unit for Operations Research in Engineering

Practical challenges often arise when implementing solutions that stem from solving vehicle routing problem instances. Unplanned external events can result in increased vehicle travel times and subsequent degradations in supply chain operational efficiency. Moreover, drivers tend to get lost and/or often travel on roads that are not suitable for the delivery vehicles utilised when they are unfamiliar with delivery routes, especially when these routes differ significantly from one day to the next. A possible solution, aimed at streamlining the practical implementation of planned delivery routes, is therefore to attempt to increase driver-route familiarity. A novel problem, called the familiarity vehicle routing problem (FVRP), is proposed for improving the practical implementation of planned delivery routes by introducing increased driver-route familiarity into vehicle delivery routes. The FVRP consists of two phases — a strategic phase and an operational phase. During the strategic phase, a set of standard delivery routes visiting each customer along a specified number of different approaches is generated for a depot and the customers it services. These routes are called master routes and are then used as blueprints for daily planning purposes when actual delivery routes are computed during the subsequent operational phase. Delivery vehicle drivers are thus be afforded the opportunity to become familiar with the master routes, which is anticipated to increase the efficiency with which they are able to perform deliveries (if the actual delivery routes do not deviate too much from these master routes). Two novel

mathematical models and accompanying approximate solution approaches are proposed for the different phases of the FVRP. The (single-objective) mathematical model for the strategic phase is concerned with generating a minimum-cost the set of master routes for a given depot and the customers it services. The set of arcs that form these master routes represent road links with which delivery vehicle drivers may become increasingly familiar as they continue to travel along them during future deliveries. The set of master route arcs are provided as input to the (bi-objective) mathematical model proposed for the operational phase of the FVRP. This model is concerned with computing multiple trade-off solutions which can serve as actual delivery routes along which the objectives are to minimise transportation cost and to maximise the portion of the total distance travelled along the master route arcs. The two proposed models and their approximate solution approaches are finally applied to a special case study, involving real-world data, in order to demonstrate the practical applicability of the FVRP.

Keywords: vehicle routing, multi-objective optimisation, metaheuristic optimisation, familiarity **Status**: Complete results

Biography of the speaker:
I am a PhD candidate in Industrial Engineering at Stellenbosch University. I obtained my undergraduate degree in Industrial Engineering from the same University in 2020. I then pursued a full time research Master's degree in Industrial Engineering also from the same University starting 2021. I completed the Master's in 2022 and it was then upgraded to doctoral studies. I handed in my dissertation in June 2023 and I am currently awaiting my doctoral defence in September. My research is conducted in the Stellenbosch Unit for Operations Research in Engineering (SUnORE) group. I was also an ad-hoc lecturer in the first semester of 2023 giving Operations Research and Non-linear Optimisation modules to final year engineering students.

A generic framework for aspect-based sentiment analysis

Bianca van Zyl*, Jan H. van Vuuren
Stellenbosch University

With the increasing volume and complexity of user-generated content shared via the Internet, the need has arisen for automated methods capable of extracting meaningful insights from freeform text data. The field of aspect-based sentiment analysis has, in particular, gained significant interest in this regard and involves the discovery of multiple topics, as well as the sentiment polarities towards these topics, present in a text document. While a plethora of promising approaches to this task have been proposed in the literature, many are limited in scope in at least one of two manners — they treat only specific subtasks of the problem, or they employ a specific model, model architecture, or features, the suitability of which may differ for data sets of different types or from different domains. In this presentation, a generic framework for aspect-based sentiment analysis is proposed. An emphasis is placed on guiding the development of machine learning models for each subtask of aspect-based sentiment analysis in respect of the specific data set under analysis. As such, the goal of the framework is to facilitate the data preparation, model development, and deployment stages of an aspect-based sentiment analysis project, bridging the gap between the current literature and the application of these techniques in practice. An instantiation of the proposed framework was implemented and validated in respect of two popular benchmark data sets, as well as a new real-world data set, the results of which are presented to demonstrate the value of such a structured model development process.

Keywords: Aspect-based sentiment analysis, natural language processing, machine learning, decision support systems
Status: Complete results

Biography of the speaker:

Bianca completed both her bachelor's and master's degrees in industrial engineering at Stellenbosch University, during which she carried out her research as a member of the Stellenbosch Unit for Operations Research in Engineering (SUnORE). Her final-year project involved modelling the spread of rabies in South African informal settlements using agent-based modelling techniques, while during her master's she delved into the fields of natural language processing and machine learning, developing a framework for aspectbased sentiment analysis. Having explored a diverse range of topics during her studies, she is now working as an environmental consultant at The Green House, aiming to utilise her skills in a field about which she is personally passionate.

Analysing student progression by means of a hybrid simulation modelling paradigm

Sha-abaan Slamang*, Lieschen Venter
Department of Logistics, Stellenbosch University

Abstract

Stellenbosch University (SU) aims to be one of the leading research institutions on the African continent. High school matriculants (both locally and internationally) can apply to SU with the hope of graduating through one of SU's ten faculties. The selection of students for enrolment into a degree programme in the Economic Management Sciences (EMS) Faculty is based on academic merit. For a student to progress to the each academic year, they must obtain the minimum academic credits required to continue. This study provides a simulation model of SU's EMS Faculty. A hybrid paradigm brings together the micro-analysis functionality of agent based simulation modelling and the macro-analysis functionality of system dynamics. This model can assist in setting policies and intervention strategies to better understand the challenges students face and how the university can assist students so that the maximum number of students graduate in minimum time.

Keywords: Simulation modelling, education systems, agent-based, system dynamics, policy setting. **Status**: Complete results.

Biography of the speaker:

Annette van der Merwe completed her PhD in Computer Science in 2018 at the North-West University in Potchefstroom. She works as a senior lecturer in Computer Science and Information Systems, presenting Decision Support Systems and Artificial Intelligence. Her research includes the development, implementation, and evaluation of mathematical modelling approaches to improve specific challenges in the tertiary educational environment.

Mobile Clinic Optimisation in the Witzenberg Region

Hannah Jarvis *, Linke Potgieter
Department of Logistics, Stellenbosch University

Many communities in South Africa do not have access to basic health care due to transportation barriers. One strategy that the Department of Health has implemented to rectify this is the introduction of mobile clinics to provide basic health care. Mobile clinics now play an instrumental role in our modern health care system, since they can provide health care to remote or underprivileged communities, in areas such as child immunisation, HIV testing and counselling, and TB screening. In the Witzenberg region, 6 mobile clinics have been deployed to service over 100 farming communities. Each of these mobile clinics has been assigned to different routes and farms within the region. One major problem that these mobile clinics face is within their daily routing and scheduling, as there is an uneven balance of the workload between the days on a mobile clinic as well as between the various mobile clinics. Thus, this study aims to develop a schedule for the mobile clinics which has a more even workload between the mobile clinics. This ensures that there is fairness in the time spent with each patient, as well as the workload of each mobile clinic. The problem is modelled with a two-phase solution. Phase one solves the problem as a vehicle routing problem with time windows. This constructs routes for the mobile clinics departing from their respective depots. Phase two then constructs monthly schedules for

each mobile clinic, ensuring that there is an even distribution between the various mobile clinics. Decision criteria have been determined through discussions with the mobile clinic doctor, focus group interviews, questionnaires and experiencing the functioning of the mobile clinics in practice. Other information such as the routes, farm population numbers and schedules have been received from the Western Cape Department of Health and Wellness.

Keywords:Mobile clinic, home health care, vehicle routing problem **Status**: Work in progress

Biography of the speaker:

Hannah Jarvis is a student in the Department of Logistics at Stellenbosch University. She completed her BSc degree in Operations Research and Applied Mathematics (cum laude) and is currently studying towards an honours in Operations Research. She has an interest in applying Operations Research to solve problems in the line of health sciences.

Operationalising Mathematical Models in Health Policy

Jared Norman*, Rachel Hounsell, Retselisitsoe Monyake, Sheetal Silal
Modelling and Simulation Hub, Africa (MASHA), University of Cape Town

Operations Research has always been both practical and multidisciplinary in nature. I spend a lot of time at the Modelling And Simulation Hub, Africa (MASHA) designing and implementing various tools to facilitate our work operationalising mathematical models that inform health policy. In this talk I will survey some of these tools, discuss the design process behind them, and give details on the technology used. Examples include: • LHSCalibration app: A web app for performing Latin Hypercube Sampling (LHS). The technique is frequently used in sensitivity analysis and calibration. This app guides the user through the process in a graphical way where the parameter distributions are specified from a spreadsheet. The app frequently supports model calibration process across a range of agent based and compartmental models. • AwaySequences: An algorithm for arranging scheduled jobs of model runs such that the partial results capture the search space maximally. This gives the user an early preview of the model output while waiting for the full results, which may take several hours or days to run. • DTPBoost: A web app which provides modelling evidence on vaccine booster doses. This app would be used by a National Immunization Technical Advisory Group (NITAG) whose role is to support decision makers in creating health policy or spending health budgets. The epidemiological and economic outputs from the tool form a part of the evidence base for the NITAG recommendations. I will cover the design and implementation process and focus on the tools we used to reach this goal. I will conclude by sharing a list of useful tools that we frequently employ in our day-to-day disease modelling research.

Keywords: Technology, Tools, Modelling **Status**: Work in progress

Biography of the speaker:

Jared Norman is a researcher at the Modelling and Simulation Hub, Africa (MASHA). He has worked in the information security field defending businesses against cyber threats but pivoted to MASHA in 2019 to fight a different kind of virus. This proved to be an interesting time to shift to disease modelling as 6 months later the world would develop quite a need for it. Since joining MASHA, he has worked on several disease transmission models. He has designed, implemented and maintained application interfaces which facilitate the communication and utility of the models and has provided various improvements to code and automation within the team.

Session VI: Miscellaneous

Analysis of the automatic autoregressive integrated moving mean model misspecification

Modisane Seitshiro *
North-West University

The analysing and forecasting time series datasets using Autoregressive Integrated Moving Average (ARIMA) models for forecasting have been challenging when there exists high variations and heavy tails. However, there have been several attempts to automate ARIMA modelling in the past two decades, making it a more accessible tool for researchers. In this study we assess model risk due to model misspecification and show that the ARIMA modelling of time series involves three primary steps: Model identification; Model Estimation and testing; and Model Application. The first step entails examining the time series for non-stationarity. If non-stationarity exists, then differencing transformation of appropriate order is used to remove it. The second step involves automatically estimating the orders of ARIMA model parameters, which is accomplished using the method of maximum likelihood. The final step entails forecasting and evaluation of the model performance. The process is applied on the Johannesburg Stock Exchange Top 40 Index with some low to high existence of volatility. Furthermore, the diagnostic checking of the developed ARIMA model is assessed using the statistical tests. If the developed model is found to be inadequate, all three steps are repeated iteratively until an adequate model is attained. Otherwise, model risk exists because of some major ARIMA assumptions been violated and a new framework is proposed. The findings shows that a robust automatic ARIMA model has benefits and limitations to manage different types of data distributions, variations in data, and outliers.

Keywords:Arima, Heteroscedasticity, Outliers, Parameter estimation, Stationarity **Status**:Complete results

Biography of the speaker:
Dr Modisane Seitshiro is currently a senior lecturer at the Centre for Business Mathematics and Informatics (BMI), North-West University. His research focus is on the Quantitative Risk Management and Applied Statistics.

A note on the construction of a nonstandard denominator function for some stochastic differential equations.

*Kenneth NK Dukuza**
University of South Africa

Construction of exact nonstandard finite difference numerical schemes for some ordinary and partial differential equations received considerable attention over the past two decades and is well documented in the literature. However, there is little information about the construction of similar schemes for stochastic differential equations (SDEs). In this talk, a scalar SDE which follows a geometric Brownian motion is considered. We use Mickens' rules of nonstandard denominator functions to derive nonstandard equations for the time differential (dt) and the Brownian motion differential (dB_t). Consequently, an exact Euler-Maruyama scheme is proposed.

Keywords: Nonstandard finite difference methods, Simulation, Stochastic processes **Status**: Complete results

Biography of the speaker:
The speaker is a researcher in the field of deterministic dynamical systems with a particular interest in bifurcation analysis, the existence of chaos phenomenon and the nonstandard numerical methods.

A game theoretical study of the pursuit of romantic happiness

Lieschen Venter*, Romain Thiry
Department of Logistics, Stellenbosch University

Human beings seek happiness in relationship. What is relational happiness and how can we find a strategy to find it given the complexity of human nature? We present a game theoretical approach to structure a romantic game able to present as faithfully as possible the interactions between two attracted individuals who may have very different personalities. A two-player non-zero game is constructed for players choosing one of sixteen strategies. These strategies depend on the personality of the players based on their Myers-Briggs Type Indicator result. Romantic happiness is a measure of the happiness a player gains by being authentic to their own personality while being compatible to the personality of their love interest. The best strategy for each player is shown to be a four-way mixed strategy. These four strategies show a bias for the player to remain faithful to their own personality type while only slightly compromising for compatibility with their interest's personality.

Keywords: Behavioural modelling, experiments in quantification, game theory **Status**: Complete results

Biography of the speaker:
Lieschen Venter is a senior lecturer and researcher at the Department of Logistics at Stellenbosch University. She is the Director of the Systems Thinking for Education Policy (STEP) research group. Beyond simulation modelling of education systems, the group seeks innovative ways to quantify unexpected metrics. This lecture features one such attempt.

District based clustering

Robert Bennetto*
Icepack

This talk will cover an introduction to the districting problem where polygons are required to be assigned to a cluster. The metric used to define the quality of a cluster based on the polygon assignment will be discussed and the intuition behind why the metric works both algorithmically and in practice. An attempt will be made in this talk to give an overview of the complexity of provisioning the data for the algorithm, the likelihood of finding a good solution (in the presence of side constraints), the overall algorithm complexity, and potentially some multi-objective exact search result benchmarks on smaller problems (time permitting).

Keywords: Clustering, multi-objective, computational geometry **Status**: Complete results

Biography of the speaker:
Rob is a founding member of the Order-of-the-computational-complexity - a religious belief that each wasted computational cycle needs to be repaid in the afterlife, by hand. As such, he spends most of his days concerned with polynomial time approximations and efficient implementations so that he can have a happy afterlife.

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2 Year

Operations Research 214 & 244
Techniques to optimise decisions in networks, for example the shortest route through a road network, the number of flights on each route for an airline (network flow), the design of a water pipe infrastructure for a new suburb. Mathematical modelling of systems via linear programming for better decision making.

Complementary subjects: Mathematics 214 & 244, Mathematical Statistics 214, 245 & 246, Computer Science 214 & 244, or Applied Mathematics 214 & 244 (if BSc)

3 Year

Operations Research 314, 322, 344 & 352
Mathematical modelling of the more complex integer type systems, for example optimal scheduling of sport tournaments, or nonlinear type systems, for example finding optimal investment portfolios, as well as preference modelling. Some additional techniques such as decision analysis for improved decision making, problem structuring to understand what the actual problem to solve is, fuzzy modelling to take uncertainty into account, simulation, queuing theory to improve long waiting times in queues, etc.

Complementary subjects: Financial Mathematics 378, Mathematical Statistics 312, 316, 344, 354 & 364, Computer Science 314, 315, 334, 344, 354 or 364, Project Management 314, or Applied Mathematics 314, 324, 354 & 364

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Talk to us

EMAIL:
Prof. Stephan Visagie
svisagie@sun.ac.za

WEB:
Department of Logistics
www.sun.ac.za/english/faculty/economy/logistics/

(1) **Bennetto** , Robert (Chalcid)
robert.bennetto.za@gmail.com

(2) **Bershteyn**, Anna (Department of Population Health at NYU Grossman School of Medicine)
anna.bershteyn@nyulangone.org

(3) **Bothma** , Elzanie (Department of Statistics, North-West University)
elzanie.bothma@nwu.ac.za

(4) **Bowditch** , (Zachary)
zdbowditch777@gmail.com

(5) **Budge** , Michaela Jayne (Department of Logistics, Stellenbosch University)
23553545@sun.ac.za

(6) **Clark** , David (Chalcid)
davidclark.orssa@gmail.co

(7) **Davis**, Emma Rose (Department of Logistics, Stellenbosch University)
23651466@sun.ac.za

(8) **De Villiers**, Marlize (Stellenbosch Unit for Operations Research in Engineering (SUnORE), Department of Industrial Engineering, Stellenbosch University) 22770410@sun.ac.za

(9) **Dikgale** , Phillemon (University of Limpopo)
Phillemon.Dikgale@ul.ac.za

(10) **Dlamini** , Anastacia (Department of Mathematical Sciences, UNISA)
dlamia@unisa.ac.za

(11) **Dukuza**, Kenneth (Department of Decision Sciences, UNISA)
dukuznkk@unisa.ac.za

(12) **Du Plessis** , Marno (Discovery Limited)
marnodp@gmail.com

(13) **Heinrich**, Bowen (Department of Logistics, Stellenbosch University)
bowenheinrich@gmail.com

(14) **Immelman**, Adele (Department of Decision Sciences, UNISA)
immelmf@unisa.ac.za

(15) **Jankowitz** , Mardi (Department of Decision Sciences, UNISA)
jankomd@unisa.ac.za

(16) **Jarvis** , Hannah (Department of Logistics, Stellenbosch University)
23546735@sun.ac.za

(17) **Jordaan**, Kerstin (Department of Decision Sciences, UNISA)
jordakh@unisa.ac.za

(18) **Kama** , Phumezile (Department of Decision Sciences, UNISA)
kamap@unisa.ac.za

(19) **Khambule**, Pretty (Department of Decision Sciences, UNISA)
khambpn@unisa.ac.za

(20) **Kubjana**, Tlou Luzarus (Department of Decision Sciences, UNISA)
kubjatl@unisa.ac.za

(21) **Luies** , Ruan (Elytica)
ruan@elytica.com

(22) **Maseko** , Ellen (Computer Science and Information Technology, Sol Plaatje University)
202000696@spu.ac.za

(23) **MaseTshaba**, Mantepu (Department of Decision Sciences, UNISA)
Emasetmt@unisa.ac.za

(24) **Mashele** , Phillip (Department of Decision Sciences, UNISA)
mashehp@unisa.ac.za
(25) **Mathebula**, Dephney (Department of Decision Sciences, UNISA)
mathed2@unisa.ac.za
(26) **Moagi** , Gomolemo (Department of Decision Sciences, UNISA)
69669023@mylife.unisa.ac.za
(27) **Mudimu**, Edinah (Department of Decision Sciences, UNISA)
mudime@unisa.ac.za
(28) **Mulaudzi**, Mmboniseni (Department of Decision Sciences, UNISA)
mulaump@unisa.ac.za
(29) **Ncube** , Sihle (Department of Decision Sciences, UNISA)
ncubebs@unisa.ac.za
(30) **Ndwandwe**, Lethani (Department of Statistics in the Natural and Agricultural Sciences, North-West University)
(31) **Netshitungulu**, Funanani (Department of Statistical Sciences, University of Cape Town)
ntsfun002@myuct.ac.za
(32) **Ngema** , S'khumbuzo Martin (Department of Decision Sciences, UNISA)
skngema3@gmail.com
(33) **Nkomo**, Nolwazi (Department of Decision Sciences, UNISA)
nkomons@unisa.ac.za
(34) **Norman**, Jared (Department of Statistical Sciences, University of Cape Town)
nrmjar001@myuct.ac.za
(35) **Rakotonirainy**, Georgina (Department of Statistical Sciences, University of Cape Town)
georgina@aims.ac.za
(36) **Ramasamy**, Sivasamy (Department of Statistics, University of Botswana)
ramasamysr@mopipi.ub.bw
(37) **Rammutla** , Kwena (Financial Sector Conduct Authority)
kwena.rammutla@fsca.co.za
(38) **Rees**, Jessica (Discovery)
jessr@discovery.co.za
(39) **Reynolds**, Patrick (Private)
patrick.reynolds.za@gmail.com
(40) **Seitshiro**, Modisane (School of Mathematical and Statistical Sciences, North-West University)
modisane.seitshiro@nwu.ac.za
(41) **Sesale** , lebogang (Department of Decision Sciences, UNISA)
sesalel@unisa.ac.za
(42) **Singh** , Shivani (Department of Decision Sciences, UNISA)
singhs2@unisa.ac.za
(43) **Slamang**, Sha-abaan (Department of Logistics, Stellenbosch University)
20818572@sun.ac.za
(44) **Snyman** , Hendrik (Department of Industrial Engineering, NWU)
as005@vodamail.co.za
(45) **Tavares**, Jared (Department of Statistical Sciences, University of Cape Town)
tvrjar001@myuct.ac.za
(46) **Terblanche**, Fanie (Elytica)
fanie@elytica.com
(47) **Van der Merwe** , Cecile (Department of Decision Sciences, UNISA)
vdmerch@unisa.ac.za
(48) **Van Deventer** , (Department of Decision Sciences, UNISA)
vdeveem@unisa.ac.za
(49) **Van Wyk**, Erica (Department of Decision Sciences, UNISA)
vanwye@unisa.ac.za
(50) **Van Wyngaard** , (Private)

maryke@npcartel.ai

(51) **Venter** , Lieschen (Department of Logistics, Stellenbosch University)
lieschenventer@gmail.com

(52) **Williams**, Handre (Private)
handre.williams@gmail.com

(53) **Xaba**, Diteboho (Department of Decision Sciences, UNISA)
xabald@unisa.ac.za

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