



Operations Research Workshop - Programme

Hahn 4, PD Hahn Building, level 6
Upper Campus, University of Cape Town
10-12 September 2025

Wednesday 10 September	
08:30 – 09:00	Registration
09:00 – 09:10	Welcoming – Georgina Rakotonirainy
09:10 – 10:30	Talk_1: Prof Franklin Djeumou Fomeni (Quebec University, Canada)
10:30 - 11:00	Tea and coffee break
11:00 – 12:00	Talk_2: Prof Sheetal Silal and Mr Retselisitsoe Monyake (MASHA, University of Cape Town)
12:00 – 13:00	Talk_3: Dr Lieschen Venter (Stellenbosch University)
13:00 - 14:00	Lunch break
14:00 – 16:00	Workshop_1: Dr Robert Bennetto (Icepack Limited)

Thursday 11 September	
09:00 – 10:30	Talk_4: Dr Robert Bennetto (Icepack Limited)
10:30 – 11:00	Tea and coffee break
11:00 – 12:00	Talk_5: Prof Renette Blignaut (University of Western Cape)
12:20 – 13:00	Talk_6: Dr Jonas Stray (Stray Analytics)
13:00 - 14:00	Lunch break
14:00 – 16:00	ORSSA award ceremony Tutorial_1: Prof Fanie Terblanche (Elytica)

Friday 12 September	
09:00 – 10:30	Tutorial_2: Prof Fanie Terblanche (Elytica)
10:30 - 11:00	Tea and coffee break
11:00 – 12:00	Talk_7: Dr Isabel Meyer (CSIR)
12:20 – 13:00	Talk_8: Prof Leanne Scott (University of Cape Town)
13:00 - 14:00	Lunch break
14:00 – 15:50	Workshop_2: Prof Franklin Djeumou Fomeni (Quebec University, Canada)
15:50 – 16:00	Closing – Georgina Rakotonirainy

Wednesday 09:10 – 10:30

Title: Some recent Advances and Applications in Operations Research: Bridging Theory and Practice

Abstract: Operations Research (OR), since its inception during World War II, has evolved into a vital discipline that leverages the power of Mathematics, Statistics, and Computer Science to address complex, real-world decision-making problems. Originally developed to enhance military effectiveness, OR has since permeated nearly every industry, demonstrating remarkable versatility and impact. In both academic and applied settings, OR continues to thrive through the dual pursuits of theoretical innovation and practical application. This presentation will offer an overview of recent research projects in which I have been actively involved, showcasing how OR methodologies can be effectively tailored to address pressing societal and industrial challenges. Each project exemplifies a unique blend of theoretical rigor and practical relevance. I will discuss the motivation behind each initiative, the mathematical and computational challenges encountered, and the tangible outcomes achieved. The projects span a diverse set of application domains, including:

- **Air Traffic Flow Management (ATFM):** Development of efficient, stakeholder-aware 4D flight trajectories that balance delays, operational costs, and air traffic control constraints—enhancing both safety and efficiency in air transportation systems.
- **Tea Production Optimization:** Formulation of cost-efficient blending strategies that replicate the desired sensory and quality attributes of tea blends while minimizing reliance on costly raw materials.
- **Smart Logistic Systems:** Design of collaborative logistics frameworks that optimize the use of residual truck capacity to consolidate goods from multiple stakeholders—reducing transportation costs, delivery delays, and greenhouse gas emissions.
- **Drinking Water Distribution Management:** Creation of optimization models to manage storage tank networks in urban water systems, aiming to minimize electricity consumption without compromising service reliability.

Through these case studies, the presentation will illustrate how modern OR continues to offer powerful solutions to both established and emerging challenges, serving as a bridge between academic research and real-world impact.

Bio:



Franklin Djeumou Fomeni is an Associate Professor of Operational Research at the University of Quebec in Montreal (UQÀM), Canada. He holds a B.Sc. and Master's in Mathematics from the University of Yaoundé I, Cameroon, a Postgraduate Diploma from the African Institute for Mathematical Sciences (AIMS) in South Africa, and an MSc in Computational and Applied Mathematics from the University of the Witwatersrand, Johannesburg. He earned his PhD in Operational Research from Lancaster University in the United Kingdom. His research focuses on both the theory and applications

of Combinatorial Optimization. On the theoretical side, he develops exact and heuristic solution methods using techniques such as cutting planes, branch-and-cut, and dynamic programming. On the applied side, his work addresses complex optimization problems in energy systems, transportation networks, logistics, air traffic flow management, and manufacturing.

Franklin's research has been published in leading journals including *Mathematical Programming*, *Transportation Research Part B*, *European Journal of Operational Research*, *Computers & Operations Research*, and *INFORMS Journal on Computing*. He recently served as a guest editor for a special issue of *Mathematical Programming*. His academic excellence has been recognized with several awards, notably the **Kingsman Prize** for the best PhD thesis in Operations Research at Lancaster University, and the **Rand Merchant Bank Gold Medal**, awarded to the top MSc student in the Faculty of Science at the University of the Witwatersrand. He currently holds a Discovery Grant from the **Natural Sciences and Engineering Research Council of Canada (NSERC)**.

Wednesday 11:00 – 12:00

Title: Developing Apps for Dynamic Models using RShiny/Posit

Abstract: In this session, we will demonstrate the basics of R Shiny and show how MASHA uses Shiny to develop applications for communicating modelling results. Participants will have the opportunity to build a basic app and explore how Shiny applications can facilitate both model development and effective communication.

Bio:



Professor Sheetal Silal is the Director the Modelling and Simulation Hub, Africa (MASHA) at the University of Cape Town in South Africa and Honorary Visiting Research Fellow in Tropical Disease Modelling at Oxford University. Her primary research area is the development and application of mathematical transmission models of vector-borne diseases and vaccine preventable diseases in South Africa, sub-Saharan Africa and globally, with a focus on supporting policy development and implementation. She recently led the development of the COVID-19 dynamic transmission models as part of the South

African COVID-19 Modelling Consortium for the Government of South Africa and continues this research to support pandemic preparedness. She is the Chair of the WHO Immunization and Vaccine Implementation Research Advisory Committee and a member of the WHO Collaboratory Technical Advisory Group.



Retselisitsoe Monyake is a research software engineer at the Modelling and Simulation Hub, Africa (MASHA) at the University of Cape Town. With expertise in data science and software development, he contributes to multiple projects by developing dynamic decision-support tools for public health and policy, as well as designing digital platforms to support climate-sensitive infectious disease modelling. He has extensive experience creating and teaching programming courses and has delivered numerous workshops on R, data visualisation and interactive dashboards for researchers and policymakers. Retselisitsoe's work includes building applications that integrate mathematical models of infectious diseases with interactive visualisations to enhance communication between modelers and decision-makers.

Wednesday 12:00 – 13:00

Title: When OR leaves the lab

Abstract: This talk explores how operations research students in South Africa are building meaningful careers across sectors. Drawing on examples from alumni of Stellenbosch University's Department of Logistics and the Systems Thinking for Education research group, I discuss how skills in simulation, optimisation, and analytics are being applied in fields such as education, finance, retail, health care, and more. I will present the kinds of roles graduates have taken up at organisations like Shoprite, Capitec, and Pepkor, as well as international placements, and reflect on the pathways that connect academic training with professional practice. The session also raises questions about how OR careers can become more visible, adaptive, and socially responsive in the current South African context.

Bio:



Dr Lieschen Venter is a senior lecturer at the Department of Logistics, Stellenbosch University. She teaches modules in simulation modelling, operations research, business analytics and her research focus is on systems thinking and simulation modelling of education systems. She is the Director of the Systems Thinking for Education Policy (STEP) research group at SU.

Wednesday 14:00 – 16:00

Title: A retrospective on project trade-offs

Abstract: The purpose of this workshop is to introduce you to some of the complexities you may experience when implementing analytic solutions to problems in industry. There are multiple trade-offs that may need to be considered, ranging from:

- human capital, skill and capacity constraints,
- information asymmetry,
- conflicts of interest,
- technical challenges,
- data quality issues,
- stakeholder alignment,
- change management,
- hidden adversaries,
- potential scope creep.

In order to guide the discovery process of an environment that is most probably foreign to most, we will retrace a project from inception that the Author worked on a number of years ago. This project was evaluated by third parties as being very successful so one may consider that it was void of friction, however, this was not the case. There were a number of key decision points in the project and a number of complexities that were unexpected when commencing the project. There were very rewarding components to the project both in terms of the people we worked with, as well as the analytic problem being tackled being rather unique.

The workshop will be structured in a interactive manner involving teams. Teams will be given time to consider different aspects of the problem which will be tabled for discussion. No laptop is required and material will be delivered digitally where necessary. The objective of the workshop is bring awareness of the different aspects of analytic project implementations and where pitfalls may lay. The hope is that should audience members find themselves in a similar position in the future, that they have some clues as to which questions to ask and how to navigate potentially intractable scenarios.

Bio:



Robert Bennetto is an accomplished Operations Researcher, with a robust background in industry applications. He holds a PhD in Industrial Engineering from Stellenbosch University, where his research focused on evolutionary search strategies in constraint programming, demonstrating the effectiveness of multi-objective optimization approaches and the extensibility of these strategies to diverse problem sets. His Master of Science degree from the University of the Witwatersrand, with a winning thesis in the 2013 ORSSA

National Students Competition, centered on dynamic bulk freight train scheduling, leading to notable efficiency improvements when implemented on South Africa's 60Mt Coal Line.

As the co-founder and Chief Technology Officer of Icepack Limited, Robert is at the forefront of democratizing cutting-edge optimization services, delivering high-performance APIs to global clients across Logistics, Insurance, and Healthcare sectors. His prior experience includes serving as Managing Director at Pivot Sciences, where he significantly grew the company and drove big data and analytics engagements with multiple corporate clients across varying sectors. He also spearheaded the adoption of big-data tools and fostered internal skills development.

Earlier in his career, as Head of Consulting and Development Manager at OPSI Systems, Robert led teams solving complex real-world optimization problems in logistics, including railway optimization and the development of dynamic train scheduling tools that garnered industry awards. His expertise also extends to actuarial and consulting roles, where he applied advanced analytical techniques to price extremal risks and solve diverse industry challenges related to financial reserves.

A recognized voice in the field, Robert is an active member of the Operations Research Society of South Africa (ORSSA), having served as National Treasurer, Johannesburg Chapter Chair and LOC Chair for the 2015 Annual Conference. He is a frequent speaker at conferences, presenting on topics such as machine learning in online environments, evolutionary search strategies, discrete optimisation and algorithmic complexity.

Thursday 9:00 – 10:30

Title: A Journey to Industrial Scheduling

Abstract: This talk provides an overview of popular formulations and exact approaches to solving classes of scheduling problems in the Vehicle Routing Problem (VRP) space. The overlap in polyhedral properties between the problem formulations and the usefulness in both solving problems directly and indirectly will be discussed. A brief history of the problems and their evolution will be provided. Finally, we will discuss challenging industry problems by example, as well as the facets of implementation and data requirements which ultimately lead to stakeholder buy in. The technical topics covered include linear programming, local search, mixed integer programming and satisfaction (SAT) methods. The theory will be light with the emphasis being placed on the real-world models and the variation between them.

Bio: Same as in Worskshop_1

Thursday 11:00 – 12:00

Title: Operations research in academia and industry: Will artificial intelligence influence these career paths?

Abstract: This presentation aims to explore the evolving landscape of Operations Research (OR), with a focus on how artificial intelligence (AI) is reshaping methodological and career trajectories. The integration of traditional OR and analytical techniques with AI-driven methods will be explored. Particular attention will be given to the growing convergence between subject matter research and AI enhancement, and its implications for curriculum design and interdisciplinary collaboration. For students and researchers, the talk highlights emerging career pathways that demand fluency in both algorithmic modelling and ethical deployment of AI-augmented decision systems. Real-world examples illustrate the shift toward dynamic, data-driven operations planning in sectors like logistics, real-time decision systems, healthcare, and infrastructure.

Bio:



Manager of the University of the Western Cape's (UWC) Data Science postgraduate programmes. Was Head or Deputy Head of the Statistics and Population Studies Department at UWC for 24 of the 33 years in the academic environment. Industry experience (9 years) prior to joining academia. Current research includes: data mining, statistical learning, predictive modelling, biostatistics, mobile security, internet access, artificial intelligence, digital inclusion and science education. South African National Research Foundation rating C2 (2023-2027).

Co-researcher on a multi-national group to determine the levels of digital inclusion in South Africa (Belgium collaborators and VLIRUOS funded 2023-2025). Member of a research team to design an Artificial Intelligence Maturity Index for South Africa (SA) (GIZ funded 2024-2025). See <https://c4ir.co.za/artificial-intelligence-ai-maturity-assessment-framework/> for more details. Published more than 79 accredited articles, 22 technical reports, presented more than 60 international and 70 national conference presentations and 64 workshop presentations. Supervised or co-supervised 36 masters and 9 PhD students. In 2021, awarded the South African Statistical Association's SAS Thought Leader Award for significant contributions in academia, industry, government and elsewhere.

For our Data Science programmes to be and remain successful, we have to continuously engage with communities and industry to ensure that we train students who are industry ready with the appropriate skills. At the 2023 UWC Academic Achievers' Awards, UWC's Data Science programmes won the prestigious 2023 UWC Community Engagement Excellence Award as the Excellent Community Engagement Team. Engagement spanned industry (local and international), school teachers and learners, and research impact nationally and globally. The programmes train employable students and embark on fund raising efforts to secure bursaries.

2025 SAS Educator Award - honoured to be recognised as one of 8 educators in the world for their contribution to education in the field of analytics, data science and AI.

Thursday 12:00 – 13:00

Title: AI/Analytics In Retail - From Problems to Solutions in 2025

Abstract: Retail companies realise that data and artificial intelligence have become essential projects to focus on in 2025, or face market share losses from lack of competitive power. There are many big players in this space, but implementation and software costs can be fraught with high risks and expenditure, especially when the organisation is unprepared and does not understand the strategic and operational implications of investing in AI.

This talk will highlight what characterises successful initiatives, what some generally valuable use-cases are that most retailers will find in their business and what the most important elements of a successful strategy are. The talk will dive into the risks involved in AI programs and implementations of off-the-shelf software, and highlight ways to mitigate those risks.

Bio:



Dr. Jonas Stray is the founder of Stray Analytics, an AI/analytics consulting & solutions provider, with 25 years experience in designing and implementing AI/analytics solutions in retail and manufacturing as well as teaching operations research, statistics and mathematics at university level.

Thursday 14:00 – 16:00 and Friday 09:00 – 10:30

Title: Modeling of Nonlinear Features in MILPs Using Special Ordered Sets Constructs

Abstract: Mixed Integer Linear Programming (MILP) is a powerful framework widely applied across operations research, engineering design, and data-driven decision-making. However, many real-world optimization problems inherently involve nonlinear relationships. For example, per-unit production costs often decrease as manufacturing volumes increase due to economies of scale, while fuel consumption in vehicles grows nonlinearly with speed or load. This tutorial introduces the formulation and application of Special Ordered Sets (SOS) of Type 1 and Type 2 to model non-convex and piecewise linear relationships. These constructs enable the efficient approximation of nonlinear dependencies between decision variables in MILP formulations. Participants will have the

opportunity to formulate and solve example problems using the Elytica platform, an online system designed to simplify the modeling and solution of MILP problems. By the end of the tutorial, attendees will gain both conceptual understanding and practical skills to enhance MILP models with nonlinear features through SOS formulations.

Bio:



Fanie holds a PhD in Computer Science from the North-West University as well as a PhD in Industrial Engineering from Stellenbosch University. He is currently managing director of Elytica, a company that provides optimization, simulation and predictive modeling as a service. He is also appointed as an extraordinary professor at the School of Industrial Engineering, North-West University, South Africa. His main research interest involves large-scale optimization problems in mining, finance, telecommunications, and logistics.

Friday 11:00 – 12:00

Title: Operations Research/ Decision support applications at CSIR

Abstract: CSIR is a national research council, with a mandate that is both government and industry-facing. As such, the organisation is in a unique position to play an essential role in innovating for improved socio-economic performance. This talk will provide an overview of selected applications in the field of logistics and supply chain management, with a focus on enhancing decision-making at national, provincial, corridor, supply chain, and sector level. Applications of information systems, simulation, and optimization applications will be presented.

Bio:



Isabel Meyer is a principal researcher at CSIR Smart Mobility, and coordinator of CSIR's Smart Logistics Management initiative. She is an Operations Researcher and veterinarian with experience in modelling, research, and analysis of complex systems. Isabel's research and consulting portfolio includes modelling and analysis of business and organisational systems, development initiatives, and logistics networks. A specific interest is the design of rural economic development initiatives and associated organisational and project structures such that sustained benefit is delivered. Her work includes development of simulation and optimisation models of logistics networks for private sector and government application, establishment of information platforms for logistics decision-making (including CSIR's Logistics Observatory) and for the integration of emerging farmers into supply chains, and co-authorship of CSIR's State of Logistics Surveys. Isabel holds PhD (Information

Systems), MSc (Industrial Systems), MBA, and BVSc degrees. She has associate roles at the Universities of Cape Town (Statistical Sciences) and Stellenbosch (Industrial Engineering).

Friday 12:00 – 13:00

Title: Problem structuring approaches in OR

Abstract: In this talk we will give a brief overview of the evolution of Problem Structuring Methods (PSM) in the field of Operational Research as well as spotlight a few commonly used methods. We will explore the philosophical and operational aspects of these methods and illustrate their use in different contexts.

Bio:



Leanne Scott is an Emeritus Associate Professor in the Statistical Sciences Department, University of Cape Town. She previously taught at Murdoch University in Western Australia and held a research post at University College London. Her research interests are Public Sector Decision Making, Multi-Criteria Decision Analysis and Problem Structuring. Her research is focussed on collaborative work with communities, NGOs and local government to structure problems, gather data, and describe the landscape within which to develop solutions. She facilitates training for community members in data collection and manages community-driven data collection initiatives.

Friday 14:00 – 16:00

Title: The Quadratic Knapsack Problem (QKP): An Exploration of Sorting Criteria in Dynamic Programming

Abstract: The Quadratic Knapsack Problem (QKP) is a well-studied combinatorial optimization problem that involves maximizing a quadratic function of binary variables, subject to a single knapsack constraint. As a generalization of the standard linear Knapsack Problem (KP), the QKP is classified as strongly NP-hard. While the KP can be solved optimally in pseudo-polynomial time using a dynamic programming (DP) algorithm, the same approach for QKP yields only a strong heuristic method. Research has shown that the effectiveness of this heuristic heavily depends on a sorting procedure applied to the items prior to executing the DP algorithm, followed by a local search afterward. However, the choice of the most effective or impactful sorting criteria remains an open question. In this session, participants will gain hands-on experience with the DP algorithm for the QKP, both with and without the existing sorting criteria. This will be followed by a collaborative discussion to explore alternative sorting strategies. Participants will then implement and evaluate these new criteria, comparing their impact against existing methods.

Bio: Same as in Talk_1