

CEMS Research Focus Areas 2027

Department	Decision Sciences	
Discipline	Operations Research and/or Quantitative Management	
Research Focus Area	Mathematical and Statistical Modelling, Heuristics and Optimisation.	
Total Capacity for 2027	40 (21 Master's and 19 PhDs)	
Supervision Team	Academic Profile	Capacity
Under normal circumstances and at the time of writing the following staff members are available and have the expertise to supervise topics in this focus area.		
Dr E Mudimu Email: mudime@unisa.ac.za	Highest qualification: PhD in Operations Research (Unisa). Research interests: Using simulation modelling to address public health questions by evaluating the impact of prevention and treatment programmes focusing on HIV and other infectious diseases. This involves a strong element of economic evaluation and cost effectiveness analysis	Master's: Up to 2 Doctorates: Up to 4
Professor Safari Mukeru ¹ (Contact person for this focus area) Email: Mukers@unisa.ac.za	Highest qualification: PhD in Operations Research (Unisa). Research interests: Stochastic Processes and Applications in Financial Modelling, Fourier Analysis, Fractal geometry and Mathematical Logic. Research in Probability and Statistical modelling in the presence of interdependent random variables. Research in Random polynomials, random matrices and applications. NRF-rated researcher (C3).	Master's: Up to 1 Doctorates: Up to 1
Professor MP Mulaudzi Email: Mulaump@unisa.ac.za	Highest qualification: PhD in Applied Mathematics (NWU). Research interests: Stochastic Control and Optimisation in Banking and Finance, Sustainable Finance, Reinforcement Learning in Mathematical Finance, Stochastic Processes.	Master's: Up to 1 Doctorates: Up to 0
Prof KM Malan Email: malankm@unisa.ac.za http://www.kmalan.co.za/	Highest qualification: PhD in Computer Science (UP). Automated algorithm selection for optimisation and learning, understanding of complex optimisation problems through fitness	Master's: Up to 3 Doctorates: Up to 3

¹ Please note that consulting the research focus area leader is no assurance that your application will be approved. If, however, your application is approved, it is also not a guarantee that he/she will be allocated as your supervisor.

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	landscape analysis and the application of computational intelligence techniques to solving real-world problems. NRF rated researcher (C1).	
Prof CJ Swanepoel Email: swanecj@unisa.ac.za	Highest qualification: PhD in Mathematics (UNISA). Research interests: Ramsey Theory. The application of combinatorial optimisation techniques in industry, the military environment and natural language processing. Practical and ethical aspects of decision making using artificial intelligence.	Master's: Up to 3 Doctorates: Up to 3
Dr P Kama Email: kamap@unisa.ac.za	Highest qualification: PhD in Applied Mathematics (University of Pretoria). Research interests: Mathematical Modelling of epidemiology, population and church growth dynamics: Numerical analysis of ODEs and PDEs for nonstandard finite difference method.	Master's: 2 Doctorates: 1

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Dr MT MaseTshaba E-mail: Emasetmt@unisa.ac.za	Highest qualification: PhD in Operations Research (SMU)	Doctorates: Up to 2
Dr EL Sesale E-mail: sesalel@unisa.ac.za	Highest qualification: PhD in Statistics (SMU) Research interests: Multivariable mathematical decision making models	Master's: Up to 1 Doctorates: Up to 2
Dr NKK Dukuzza E-mail: dukuznkk@unisa.ac.za	Highest qualification: PhD in Mathematical Sciences (UP) Research interests: (i) General Mathematical Modeling of continuous and discrete systems with emphasis on local analysis of their dynamical behaviours which may exhibit bifurcation and chaos. (ii) Construction of nonstandard finite difference numerical schemes that preserve dynamical properties of continuous models such as positivity of solutions, equilibria and stability of equilibria.	Master's: Up to 2 Doctorates: Up to 1
Dr LD Xaba E-mail: xabald@unisa.ac.za	Highest qualification: PhD (NWU) Research interests: Operations Research, Statistical Science, Financial Econometrics	Master's: Up to 2 Doctorates: Up to 1
Dr S Singh E-mail: singhs2@unisa.ac.za	Highest qualification: PhD (Wits) Research interests: Mathematical Analysis	Master's: Up to 2 Doctorates: Up to 1
Dr PN Khambule E-mail: khambpn@unisa.ac.za	Highest qualification: PhD (UKZN) Research interests: General Relativity, Exact solutions of the field equations, Cosmology	Master's: Up to 1
Ms NS Nkomo E-mail: khambpn@unisa.ac.za	Highest qualification: MSc (UKZN) Research interests: Fractional calculus, Numerical methods, Fluid dynamics, Mathematical modelling, Biomathematics	Master's: Up to 1

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Selection Criteria: MSc, MCom and PhD	Refer to the qualification website for selection criteria.
Selection Procedure	Refer to the qualification website for selection procedure.
Research Scope	In Decision Sciences the focus at Master's and PhD level is the application of existing advanced mathematical techniques to a new and demanding problem or the further development of such techniques, algorithms or mathematical theory relevant to the practice of Operations Research and/or Quantitative Management and Finance
Reading: Subject Field	To be determined once a topic has been identified.
Reading: Research Methodology	Departmental Honours project study material.
Resources: Scholar Community	N/A
Potential M&D Research Focus	
Unit of Analysis	Research Focus
	We work on modelling real-life problems in the broader context of decision making using various techniques from Mathematics, Statistics and Computational theory. We also focus on some theoretical aspects behind these techniques to gain new insight for the development of new algorithms. Some recent papers/manuscripts Malan, K.M. (2021). A Survey of Advances in Landscape Analysis for Optimisation, <i>Algorithms</i>, 14(2), DOI:10.3390/a14020040. 2. Ochoa, G., Malan, K.M. and Blum, C. (2021). Search trajectory networks: A tool for analysing and visualising the behaviour of metaheuristics, <i>Applied Soft Computing</i>, 109, DOI:10.1016/j.asoc.2021.107492 3. Stapelberg, B. and Malan, K.M. (2020). A survey of benchmarking frameworks for reinforcement learning, <i>South African Computer Journal</i>, 32(2): 258-292, DOI:10.18489/sacj.v32i2.746. 4. Safari Mukeru: On the convergence of series of dependent random variables. To appear in the Journal of Theoretical Probability. 5. Mpanda, Mukeru and Mulaudzi: Generalisation of Fractional Cox-Ingersoll-Ross Process. <i>Results in Applied Mathematics</i> 15(2): 100322.

	6. Mukeru, S and Mulaudzi, MP (2022). Zeros of Gaussian power series, Hardy spaces and determinantal point processes. <i>Annals of Functional Analysis</i>, 13(1), 1-23. 7. Mukeru, Mulaudzi, Nzabanita, Mpanda: Zeros of Gaussian power series with dependent random variables. Illinois Journal of Mathematics, 2021. 8. Safari Mukeru: Average Number of Real Zeros of Random Algebraic Polynomials Defined by the Increments of Fractional Brownian Motion (Journal of Theoretical Probability, 2019, 32:1502–1524). 9. Mazibuko, T.C. and Malan, K.M. (2020). Machine Learning for Improved Boiler Control in the Power Generation Industry. In <i>Proceedings of the First Southern African Conference for Artificial Intelligence Research</i>, pp 148-161, SACAIR Online Proceedings. 10. Mudimu, E. and Engelbrech, G.N. Agent-based model for social and sexual partnerships formation (Adaptive Behavior, 2015) doi.org/10.1177/1059712314547709 11. Amouzouvi, K., Assamagan, K.A., Azote, S., Connell, S.H., Fankam, J.B.F., Fanomezana, F., Guga, A., Haliya, C.E., Mabote, T.S., Macucule, F.F. and Mathebula, D., 2021. A model of COVID-19 pandemic evolution in African countries. <i>Scientific African</i>, 14, p.e00987. 12. Dukuza, K.; <i>Construction of some discrete 4-D hyper-chaotic systems</i>. Annual Review of Chaos Theory, Bifurcations and Dynamical Systems, Vol. 10, (2021), 30-40, www.arctbds.com. 13. Dukuza, K.; <i>Bifurcation analysis of a computer virus propagation model</i>. Hacettepe Journal of Mathematics and Statistics, 50(5) (2021), 1384-1400. 14. Dukuza, K.; <i>Chaos in a discrete cancer model</i>. Journal of Applied Nonlinear Dynamics, 11(2) (2022), 297-308:
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