

H9MSO: Modelling, Simulation & Optimization

Module Code:	H9MSO
Long Title	Modelling, Simulation & Optimization APPROVED
Title	Modelling, Simulation & Optimization
Module Level:	LEVEL 9
EQF Level:	7
EHEA Level:	Second Cycle
Credits:	10
Module Coordinator:	Shauni Hegarty
Module Author:	Margarete Silva
Departments:	School of Computing
Specifications of the qualifications and experience required of staff	
Learning Outcomes	
<i>On successful completion of this module the learner will be able to:</i>	
#	Learning Outcome Description
LO1	Categorize different types of simulation, modelling, and optimisation technologies
LO2	Implement and test a conceptual model using a simulation tool
LO3	Critically analyse output data produced by a model and test the validity of the model
LO4	Perform optimisation according to chosen criteria
LO5	Comprehend, reflect on and combine some of the most commonly used modelling and simulation methods and optimisation heuristics
Dependencies	
Module Recommendations	
No recommendations listed	
Co-requisite Modules	
No Co-requisite modules listed	
Entry requirements	

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Module Content & Assessment			
Indicative Content			
Linear Programming Linear Programming, application in production planning			
Discrete optimisation techniques Integer programming, constraint programming, application in scheduling			
General optimisation, Multi-objective optimisation Test Problems, Classical methods, advanced Methods, Pareto optimality			
Metaheuristics Local search. Simulated annealing. Tabu search. Variable neighbourhood search, applications.			
Evolutionary algorithms Genetic algorithms Swarm intelligence Memetic algorithms swarm intelligence			
Hybrid metaheuristics and Applications Combining metaheuristics with mathematical programming, constraint programming, application in machine learning and datamining, applications in Decision Support Systems			
Introduction to Simulation Concept of system, model and simulation, simulation methodologies, components of discrete event simulation, verification and validation of simulation systems			
Queueing system Characteristic of a queueing system, Simulation of single server queueing system			
Output data analysis for single server system Probability distribution functions, Estimation of statistical parameters, Applications of Single Server Systems			
Integrated Simulation Studies Statistical models in simulation, Object-Oriented Simulation, Building a larger simulation system intelligence			
Continuous Simulation Use of Differential Equations, Runge-Kutta Integration, Predator-Prey Systems, Infectious Disease Modelling			
Agent-Based Simulation Verification, validation and credibility of simulation models, simulation of manufacturing, crowd simulation			
Assessment Breakdown			%
Coursework			60.00%
End of Module Assessment			40.00%
Assessments			
Full Time			
Coursework			
Assessment Type:	Formative Assessment	% of total:	Non-Marked
Assessment Date:	n/a	Outcome addressed:	1,2,3,4,5
Non-Marked:	Yes		
Assessment Description: Formative assessment will be provided on the in-class individual or group activities. Feedback will be provided in written or oral format, or on-line through Moodle. In addition, in class discussions will be undertaken as part of the practical approach to learning.			
Assessment Type:	Project	% of total:	60
Assessment Date:	n/a	Outcome addressed:	2,3,4
Non-Marked:	No		
Assessment Description: Long-form project which the student produces over the course of the entire semester. Student is required to model and simulate a process (production scheduling, planning, gaming, traffic, operating theatre) using a simulation tool using an open source simulation tool			
End of Module Assessment			
Assessment Type:	Terminal Exam	% of total:	40
Assessment Date:	End-of-Semester	Outcome addressed:	1,5
Non-Marked:	No		
Assessment Description: Terminal assessment exam taken over 2 hours with four questions of which the student must answer three to address the students' understanding of the underlying theories and concepts			
No Workplace Assessment			
Reassessment Requirement			
Repeat examination <i>Reassessment of this module will consist of a repeat examination. It is possible that there will also be a requirement to be reassessed in a coursework element.</i>			
Reassessment Description The repeat strategy for this module is an examination. All learning outcomes will be assessed in the repeat exam.			

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Module Workload				
Module Target Workload Hours 0 Hours				
Workload: Full Time				
Workload Type	Workload Description	Hours	Frequency	Average Weekly Learner Workload
Lecture	Classroom & Demonstrations (hours)	24	Every Week	24.00
Tutorial	Other hours (Practical/Tutorial)	24	Every Week	24.00
Independent Learning	Independent learning (hours)	202	Every Week	202.00
Total Weekly Contact Hours				48.00

Module Resources	
<i>Recommended Book Resources</i>	
Borshchev, A.. (2014), , The Big Book of Simulation Modeling: Multimethod Modeling with Anylogic 6, AnyLogic North America. Choi, B.K. & Kang, D.. (2013), , Modeling and Simulation of Discrete Event Systems, Wiley Press. Banks , J.. (2010), , Discrete-Event System Simulation, Pearson Education. Simon, D.. (2013), Evolutionary Optimization Algorithms, Wiley. Alan Sultan. (2011), Linear Programming, CreateSpace, p.646, [ISBN: 978-1463543679]. Mandal, J.K & Mukhopadhyay, S. & Dutta, P.. (2018), Multi-Objective Optimization: Evolutionary to Hybrid Framework, Springer Singapore.	
<i>Supplementary Book Resources</i>	
Kelton, W.D., Sadowski, R., and Zupick, N.. (2014), , Simulation with Arena, McGraw-Hill. Evans, J.R. & Olson, D.L.. (2001), , Introduction to Simulation and Risk Analysis, Prentice Hall. Zeigler, B.P., Praehofer, H. & Kim, T.G.. (2000), , Theory of Modeling and Simulation: Integrating Discrete Event, and Continuous Complex Dynamic Systems, Elsevier Academic Press.	
<i>This module does not have any article/paper resources</i>	
<i>This module does not have any other resources</i>	
Discussion Note:	