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	
On successful completion of this module the learner will be able to:	
#	**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
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.

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

Recommended Book Resources

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.

Supplementary Book Resources

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.

This module does not have any article/paper resources

This module does not have any other resources

Discussion Note:	