H8SMSOA: Systems Modelling, Simulation & Optimization for Analytics

Module Code:	H8SMSOA
Long Title	Systems Modelling, Simulation & Optimization for Analytics APPROVED
Title	Systems Modelling, Simulation & Optimization for Analytics
Module Level:	LEVEL 8
EQF Level:	6
EHEA Level:	First Cycle
Credits:	10
Module Coordinator:	Ade Fajemisin
Module Author:	Ade Fajemisin
Departments:	School of Computing
Specifications of the qualifications and experience required of staff	Master's degree or PhD in a computing or cognate discipline. May have industry experience also.

Learning Outcomes	
On successful completion of this module the learner will be able to:	
#	**Learning Outcome Description**
LO1	Categorize different types of simulation modelling technologies
LO2	Implement a conceptual model using a simulation tool
LO3	Generate and test random number variates and apply them to develop simulation models
LO4	Derive correct and efficient sampling algorithms for given probability distributions
LO5	Analyse output data produced by a model and test the validity of the model
LO6	Perform optimisation according to chosen criteria

Dependencies
Module Recommendations
No recommendations listed
Co-requisite Modules
No Co-requisite modules listed

Entry requirements	Learners should have attained the knowledge, skills and competence gained from stage 3 of the BSc (Hons) in Data Science

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Module Content & Assessment

Indicative Content
Introduction Concept of system, model and simulation, components of discrete event simulation
Simulation methodologies Continuous, discrete, Monte Carlo, agent-based, system dynamics, games and virtual worlds
Mathematical modelling languages for the description of distributed systems Petri nets, UML activity diagrams, Event-driven process chains, Markov chains, etc.
Statistical models Statistical models in simulation, Probability distribution functions, Estimation of statistical parameters.
Random numbers Generation of random number and random number variables, testing of random numbers.
Queueing system Characteristic of a queueing system, Simulation of single server queueing system
Input modelling Estimation of parameters, Fit tests of distributions
Output data analysis for single system Statistical analysis for terminating and non-terminating simulations, comparing alternative system configurations
Testing Verification, validation and credibility of simulation models, simulation of manufacturing, material handling systems, traffic
Simulation-based optimization Statistical ranking and selection methods, response surface methodology, heuristic methods, derivative-free optimization methods
Advanced optimization techniques Metaheuristics (genetic algorithms, simulated annealing, tabu search, etc.)
Case studies Production scheduling, planning, gaming, traffic, healthcare. Ethics aspects

Assessment Breakdown	%
Coursework	60.00%
End of Module Assessment	40.00%

Assessments

Full Time

Coursework

Assessment Type:	Continuous Assessment	**% of total:**	Non-Marked
Assessment Date:	n/a	**Outcome addressed:**	1,2,3,4,5,6
Non-Marked:	Yes		

Assessment Description:
Ongoing independent and group problem solving activities and feedback.

Assessment Type:	Project	**% of total:**	60
Assessment Date:	n/a	**Outcome addressed:**	2,3,4,5,6
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:**	1,2,3,4,5,6
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	Per Semester	2.00
Tutorial	Other hours (Practical/Tutorial)	24	Per Semester	2.00
Independent Learning	Independent learning (hours)	202	Per Semester	16.83
			Total Weekly Contact Hours	4.00

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.

Altiok, T. & Melamed, B.. (2007), Simulation Modeling and Analysis with Arena, Elsevier Academic Press.

Banks , J.. (2010), , Discrete-Event System Simulation, Pearson Education.

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:	