

# Unit Outline (Higher Education)

**Institute / School:** Institute of Innovation, Science & Sustainability

**Unit Title:** Computational Methods for Data Analysis

**Unit ID:** MATHS7002

**Credit Points:** 15.00

**Prerequisite(s):** (STATS5000)

**Co-requisite(s):** Nil

**Exclusion(s):** Nil

**ASCED:** 010199

## Description of the Unit:

This unit is aimed at students who are interested in the application of computational methods to solve various problems in data analysis and in particular, to solve a variety of optimisation problems. In this unit you will be provided with a comprehensive introduction to numerical methods of linear algebra, optimisation and to numerical methods applied to model and solve problems in data science. It would be particularly valuable to prospective data scientists in improving their understanding of basic computational approaches and techniques in data science. This unit can be used by students interested in pursuing more advanced mathematical units, particularly in the areas of Computing, Information Technology and Data Science.

**Grade Scheme:** Graded (HD, D, C, P, MF, F, XF)

## Work Experience:

No work experience

**Placement Component:** No

**Supplementary Assessment:** Yes

Where supplementary assessment is available a student must have failed overall in the Unit but gained a final mark of 45 per cent or above, has completed all major assessment tasks (including all sub-components where a task has multiple parts) as specified in the Unit Description and is not eligible for any other form of supplementary assessment.

## Course Level:

Level of Unit in Course	AQF Level of Course					
	5	6	7	8	9	10
Introductory	■	■	■	■	■	■
Intermediate	■	■	■	■	✓	■
Advanced	■	■	■	■	■	■

### Learning Outcomes:

#### Knowledge:

- K1.** Examine application of linear algebra in data science.
- K2.** Investigate the techniques of graph theory and decision trees for solving data science problems
- K3.** Analyse various optimisation models used in data science.
- K4.** Analyse various optimality conditions used in optimisation problems to obtain optimum solutions.
- K5.** Evaluate and apply optimisation methods to solve both unconstrained and constrained problems, ensuring local and global optimal solutions are obtained.
- K6.** Critically evaluate optimisation techniques, considering their applicability to diverse and complex problems that may not have unique solutions in the field of data science.

#### Skills:

- S1.** Decompose authentic problems into sub components and apply appropriate optimisation techniques to solve them.
- S2.** Design algorithms based on optimisation models, incorporating linear algebra, graph theory, and decision trees for solving complex data science challenges.
- S3.** Model various data science problems using optimisation and numerical linear algebra techniques.

#### Application of knowledge and skills:

- A1.** Apply optimisation techniques for solving various data science problems

#### Unit Content:

This unit comprises a range of numerical analysis and mathematical optimisation approaches and methods to solve various data mining problems. It contains material which will be of interest and relevant to data science students who seek to develop mathematical modelling and solution methods in data mining. The unit provides valuable enrichment material for those students intending to become data analysts or data scientists. Topics may include: Multivariate calculus, derivatives, Hessians, Jacobians; chain rules; approximations of functions Methods of numerical linear algebra Graph theory, decision trees, Markov chains Elements of optimisation theory, the design of optimisation algorithms. Necessary and sufficient optimality conditions. Unconstrained optimisation, gradient methods. Conjugate gradient, Newton and quasi-Newton methods. Numerical methods for constrained optimisation. Optimisation models and methods in the supervised data classification. Methods of Evolutionary optimisation

#### FEDTASKS

Federation University Federation recognises that students require key transferable employability skills to prepare them for their future workplace and society. FEDTASKS (**T**ransferable **A**tttributes **S**kills and **K**nowledge) provide a targeted focus on five key transferable Attributes, Skills, and Knowledge that are embedded within curriculum, developed gradually towards successful measures and interlinked with cross-discipline and Co-

operative Learning opportunities. *One or more FEDTASK, transferable Attributes, Skills or Knowledge must be evident in the specified learning outcomes and assessment for each FedUni Unit, and all must be directly assessed in each Course.*

FEDTASK attribute and descriptor		Development and acquisition of FEDTASKS in the Unit	
		Learning Outcomes (KSA)	Assessment task (AT#)
FEDTASK 1 Interpersonal	Students at this level will demonstrate an advanced ability in a range of contexts to effectively communicate, interact and work with others both individually and in groups. Students will be required to display high level skills in-person and/or online in: <ul style="list-style-type: none"> <li>• Using and demonstrating a high level of verbal and non-verbal communication</li> <li>• Demonstrating a mastery of listening for meaning and influencing via active listening</li> <li>• Demonstrating and showing empathy for others</li> <li>• High order skills in negotiating and conflict resolution skills</li> <li>• Demonstrating mastery of working respectfully in cross-cultural and diverse teams.</li> </ul>	Not applicable	Not applicable
FEDTASK 2 Leadership	Students at this level will demonstrate a mastery in professional skills and behaviours in leading others. <ul style="list-style-type: none"> <li>• Creating and sustaining a collegial environment</li> <li>• Demonstrating a high level of self-awareness and the ability to self-reflect and justify decisions</li> <li>• Inspiring and initiating opportunities to lead others</li> <li>• Making informed professional decisions</li> <li>• Demonstrating initiative in new professional situations.</li> </ul>	Not applicable	Not applicable
FEDTASK 3 Critical Thinking and Creativity	Students at this level will demonstrate high level skills in working in complexity and ambiguity using the imagination to create new ideas. Students will be required to display skills in: <ul style="list-style-type: none"> <li>• Reflecting critically to generate and consider complex ideas and concepts at an abstract level</li> <li>• Analysing complex and abstract ideas, concepts and information</li> <li>• Communicate alternative perspectives to justify complex ideas</li> <li>• Demonstrate a mastery of challenging conventional thinking to clarify complex concepts</li> <li>• Forming creative solutions in problem solving to new situations for further learning.</li> </ul>	Not applicable	Not applicable
FEDTASK 4 Digital Literacy	Students at this level will demonstrate the ability to work competently across a wide range of tools, platforms and applications to achieve a range of tasks. Students will be required to display skills in: <ul style="list-style-type: none"> <li>• Mastering, exploring, evaluating, managing, curating, organising and sharing digital information professionally</li> <li>• Collating, managing complex data, accessing and using digital data securely</li> <li>• Receiving and responding professionally to messages in a range of professional digital media</li> <li>• Contributing competently and professionally to digital teams and working groups</li> <li>• Participating at a high level in digital learning opportunities.</li> </ul>	Not applicable	Not applicable

FEDTASK attribute and descriptor		Development and acquisition of FEDTASKS in the Unit	
		Learning Outcomes (KSA)	Assessment task (AT#)
FEDTASK 5 sustainable and Ethical Mindset	Students at this level will demonstrate a mastery of considering and assessing the consequences and impact of ideas and actions in enacting professional ethical and sustainable decisions. Students will be required to display skills in: <ul style="list-style-type: none"> <li>• Demonstrate informed judgment making that considers the impact of devising complex solutions in ambiguous global economic environmental and societal contexts</li> <li>• Professionally committing to the promulgation of social responsibility</li> <li>• Demonstrate the ability to evaluate ethical, socially responsible and/or sustainable challenges and generating and articulating responses</li> <li>• Communicating lifelong, life-wide and life-deep learning to be open to the diverse professional others</li> <li>• Generating, leading and implementing required actions to foster sustainability in their professional and personal life</li> </ul>	Not applicable	Not applicable

### Learning Task and Assessment:

Learning Outcomes Assessed	Assessment Tasks	Assessment Type	Weighting
K1, K2, K3, K4, K5, K6, S1, S2, S3, A1	Computational methods for data science	Assignments/Quizzes	10%-30%
K1, K2, K3, K4, K5, K6, S1, S2, S3, A1	Application of computational methods for solving data science problems including those that may not have obvious solutions and/or those may require decomposition.	Presentation/Project/Report	20% - 30%
K1, K2, K3, K4, K5, K6, S1, S2, S3	Computational methods for solving optimisation problems in data science	Final test	40% - 60%

### Adopted Reference Style:

APA ()

Refer to the [library website](#) for more information

Fed Cite - [referencing tool](#)